

REMARKS

Claims 18-41 are present in this application. Claims 1-17 have been canceled.

Claims 38-41 have been added.

Claim 18 is directed to a fuel filter comprising

a filter housing, at least one fuel inlet provided on the filter housing, at least one fuel outlet provided on the filter housing (see, paragraph 35, "In Fig. 1, a fuel filter is shown schematically, with a housing 1 on whose upper side wall a fuel inlet 2 and a fuel outlet 3 are provided on diametrically opposite sides"),

a means located in the filter housing for separating water from the fuel (see, paragraph 35, "It is quite familiar to one skilled in the art how a filter for filtering the fuel can be located in a fuel filter housing, . . ."),

at least one sump located in the filter housing for collecting the water separated from the fuel (see, paragraph 35, "The lower region of the housing 1 serves as a sump 4 for water that is precipitated out in the filtration of the fuel"),

a water outlet provided on the filter housing associated with the sump (see, paragraph 35, "A water outlet 5 with a controllable closure is provided on the bottom of the sump 4"),

control means for the water outlet (see, paragraph 35, "The closure is controlled via a control unit 6 as a function of the fill level signals of an upper water level sensor 7 and a lower water level sensor 8"),

and means for separating contaminants from the water to be drained off from the sump, said means for separating contaminants from the water to be drained off from the

sump being located inside a container and the container is mounted on the filter housing (see, paragraph 36, “ The line 9 ends in a container 11, located below the housing 1, that is open toward the top. An absorbent material 12 for absorbing water carried away from the sump 3 is located in the interior of the container . . . ” and Figs. 1 and 5).

New claim 39 requires a “means for separating contaminants from the water to be drained off from the sump located directly at the water outlet.” The support for the language “located directly at the water outlet” is found in paragraph 14 (“This additional filter may for instance be located directly at the water outlet of the fuel filter, or . . .”).

New claim 40 requires “an absorbent material, placed at the water outlet, which absorbs water carried away from the sump of the fuel filter and holds the water until the water has evaporated.” Support for the language is found in paragraph 19 (“. . . the water absorption and evaporation unit has an absorbent material . . . which absorbs water, carried away from the sump of the fuel filter, and holds it until the water has evaporated completely. Depending on the absorbency of the material, it may simply be placed at the water outlet of the fuel filter . . . “).

New claim 41 requires “a filter body adjoining the control means for cleaning the water drained from the sump.” Support for the language is found at paragraph 46 (“In Fig. 5, the sump 51 of a fuel filter is shown, with a water outlet 52 which can be opened and closed via an electromagnetically closable valve 53, and which is adjoined by a filter body 54, by which the water drained from the sump 51 is cleaned, so that it can be released directly to the environment”).

Claims 18, 21, 24 and 26-32 stand rejected under 35 UCS 102(e) as anticipated by Harenbrock et al (US 2003/0121860).

Claims 19 and 22 stand rejected under 35 UCS 103(a) as unpatentable over Harenbrock et al in view of Bradford (US 5,951,862).

Claims 20 and 23 stand rejected under 35 UCS 103(a) as unpatentable over Harenbrock et al in view of Amini (US 5,879,543).

Claims 25 and 27 stand rejected under 35 UCS 103(a) as unpatentable over Harenbrock et al in view of Hall (US 4,334,989).

Claim 33 stands rejected under 35 UCS 103(a) as unpatentable over Harenbrock et al in view of Gough (US 3,868,321) or McVay (US 3,508,658) or Muller (US 3,685,655).

Claims 34 and 35 stand rejected under 35 UCS 103(a) as unpatentable over Harenbrock et al in view of Tarr (US 5,534,161).

Claims 36 and 37 stand rejected under 35 UCS 103(a) as unpatentable over Harenbrock et al in view of any one of Jackson (US 4,264,442) or Davis (US 4,539,109) or Yasuhara (US 4,491,143).

Applicants have submitted herewith a Declaration (actually, three identical Declarations, one signed by De La Azuela on April 21, 2009, one signed by Rodriguez-Amaya on April 23, 2009 and one signed by Gruen on April 15, 2009) under 37 CFR 1.131 signed by all of the inventors establishing their conception of the invention in Germany, a WTO country, prior to December 6, 2002, the effective date of Harenbrock et al and a Declaration under 37 CFR 1.131 by Ivo Stute, a German patent attorney who was responsible

for the preparation and filing of applicants' German priority application No. 10261742.2 from which benefits are claimed under 35 U.S.C. 119.

Also, submitted herewith are English translations of German application Nos. 10261742.2, filed on December 30, 2002 and 10350781.7, filed on October 30, 2003. Certified copies of the German applications are already present in the file.

Each of the claims present in this application finds support as required by 35 USC 112, 1st paragraph, in German application No. 10261742.2, filed on December 30, 2002, because the drawings in this application and in German application No. 10261742.2 are identical. In addition, the specifications are identical, except that the two sentences in paragraph 12, which are underlined and in bold below, and all of paragraph 24, also reproduced below, are not present in German application No. 10261742.2. These passages were added to applicants' present specification by German application No. 10350781.7.

[0012] In an extremely simple embodiment of the invention, unlike the fuel filters known before and described at the outset, the sump is associated with the clean side of the filter. The water contained in the fuel can be precipitated out, for instance by way of a suitable coating on the clean side of the filter. **Depending on the embodiment, an arrangement in which the sump is associated with the dirty side of the filter may be as effective, or even more effective. In that case, the water is separated out for instance with the aid of a coating provided on the dirty side of the filter.**

[0024] **A valve for closing the water outlet can be actuated mechanically via a floating body, without requiring electrical water sensors or other electrical components for releasing the water. Once a maximum water level is exceeded, the floating body, located at the phase boundary between the fuel and water, lifts a valve, so that water is released, and it closes the valve again when a minimum water level is reached or undershot, depending on the type of embodiment.**

The sentences added to paragraph 12 contain no new matter compared to the disclosure of German application No. 10261742.2, because the first sentence in paragraph 14, which was present in German application No. 10261742.2, already discloses an alternative embodiment in which the sump is located on the dirty side of the fuel filter.

Paragraph 24 is not new matter when compared to the disclosure of German application No. 10261742.2, because all of the subject matter disclosed in paragraph 24 is found in Fig. 4 and in paragraph 45, which were present in German application No. 10261742.2.

German application No. 10261742.2 constitutes a constructive reduction to practice of the invention defined in each of the claims now present in this application. The Declaration under 37 CFR 1.131 signed by the inventors declares that the claimed subject matter of the present application was conceived in Germany before December 6, 2002. In support, the inventors' Declarations are accompanied by a copy of invention report No. EM 2000/2037. An English translation of EM 2000/2037 is also enclosed. As permitted by MPEP 715.07, the dates on the invention report have been redacted.

Invention report No. EM 2000/2037 includes: (1) an Appendix 2 which is essentially identical to Fig. 2 of the present application; (2) a figure found in Appendix 1 which is essentially identical to Fig. 3 of the present application; (3) a figure in Appendix 3 which is essentially identical to Fig. 4 of the present application; and (4) a figure in Appendix 5 which is essentially identical to Fig. 5 of the present application.

The Declaration of Ivo Stute establishes diligence from a date prior to December 6, 2002 to the priority date of December 30, 2002 (the date of constructive reduction to practice).

The Stute Declaration establishes that in the second half of 2002, Robert Bosch GmbH asked Stute to prepare patent applications on the basis of six different invention reports; that the first two of the six orders were received at the beginning of August 2002 (one of which being based on invention report EM 2002/0417 of Mr. de la Azuela, and assigned attorney docket No. 390/02001) and the other four orders were received between November 14 and November 25, 2002, including the order letter regarding the invention report EM 2000/2037 of Mr. Rodriguez-Amaya and Mr. Gruen, which was received on November 25, 2002 (assigned docket No. 390/02006); that a first draft specification on the basis of invention report EM 2002/0417 was sent to Robert Bosch GmbH on November 14, 2002, and a final draft on December 12, 2002; that Stute was asked by Robert Bosch GmbH whether it would be useful to combine the inventions reported in EM 2000/2037 and EM 2002/0417 in one application, since the two reports were closely related to each other; that, subsequently, Stute incorporated the information of EM 2000/2037 into the final draft of December 12 regarding EM 2002/0417, adapted the set of claims and filed it with the German Patent and Trademark Office on December 30, 2002. A copy of invention report No. EM 2002/0417 and an English translation of EM 2002/0417 are also enclosed.

In light of the 37 CFR 1.131 Declarations discussed above, Harenbrock et al is not prior art. Withdrawal of the rejections based on Harenbrock et al is respectfully requested.

Furthermore, even if Harenbrock et al is prior art, none of claims 18-41 are anticipated by Harenbrock et al or rendered obvious in view of the teachings in Harenbrock et al, alone, or in combination with any or all of the other applied references.

Harenbrock et al teaches a method and apparatus for storing water separated from fuel. The apparatus includes an absorber 16 filled with one or more absorbents 18, 20 which are capable of absorbing hydrocarbons from the fuel and /or water. See, paragraph 29. The apparatus also includes a line 12 connecting the absorber 16 to the accumulator 8 of a fuel filter 6 and a drain valve or stop cock 14 situated in line 12.

Claim 18 requires, inter alia, a means, located inside a container, for separating contaminants from the water to be drained off from the sump, and the container must be mounted on the filter housing.

Broadly speaking, Harenbrock et al teaches a “container” 16 that includes one or more absorbents 18, 20 which are capable of absorbing hydrocarbons from the fuel and /or water. However, Harenbrock et al does not teach that the “container” 16 “is mounted on the filter housing” as recited in claim 18. To the contrary, Harenbrock teaches that the component 16 is separated from the filter housing 6 by a line extending between the filter housing and the component 16. In fact, the impression given by Harenbrock is that the component 16 is located remotely from the filter 6 and would be supported at a location other than on the filter housing. Thus, Harenbrock cannot be said to anticipate claim 18.

New claim 39 requires, inter alia, a means for separating contaminants from the water to be drained off from the sump located directly at the water outlet. New claim 40 requires,

inter alia, an absorbent material, placed at the water outlet, which absorbs water carried away from the sump of the fuel filter and holds the water until the water has evaporated. New claim 41 requires, inter alia, a filter body adjoining the control means for cleaning the water drained from the sump.

The “means for separating contaminants from the water to be drained off from the sump” might be read on the component 16 in Harenbrock, but not the line 12. The line 12 does not separate contaminants from the water to be drained off from the sump. One end of the line 12 is “directly at the water outlet,” but certainly not the component 16. Thus, claim 39 is not anticipated by Harenbrock.

The absorbent material 18, 20 of Harenbrock is enclosed in the component 16, which is spaced from the filter housing by the line 12. One end of the line 12 is placed at the water outlet, but not the absorbent material 18, 20. Thus, claim 40 is not anticipated by Harenbrock.

Claim 41 requires a water outlet associated with the sump, a control means for the water outlet and a filter body adjoining the control means for cleaning the water drained from the sump.

Two objects are “adjoining” if they are next to or in contact with one another. This is exactly what is illustrated in applicants’ Fig. 5. Under the usual and customary meaning of the word “adjoining” two objected separated from one another, as by a length of pipe or tubing, cannot be said to be “adjoining.” The filter body 18, 20 in Harenbrock is not in contact with or next to the valve 14. To the contrary, the filter body 18, 20 is spaced from the

valve 14 by the line 12. Thus, the filter body 18, 20 in Harenbrock does not “adjoin” the valve 14 and claim 41 is not anticipated by Harenbrock.

In fact, none of Harenbrock, Bradford, Amini, Hall, Gough, McVay, Muller, Tarr, Jackson, Davis, and Yasuhara teach the particular elements of applicants’ claims 18, 39, 40 and 41 disposed in the manner specifically required by those claims. Therefore, even if it had been obvious to combine the teachings of Harenbrock with the teachings of one or more of Bradford, Amini, Hall, Gough, McVay, Muller, Tarr, Jackson, Davis, and Yasuhara, one of ordinary skill would not have arrived at the subject matter defined by claims 18, 39, 40 or 41 or any of the claims dependent thereon.

Claims 18, 19 and 32 stand rejected under 35 USC 102(b) as anticipated by or, in the alternate, under 35 USC 103(a) as unpatentable over Kasten (US 3,368,681) alone or further in view of Kasten (US 2,864,505).

Considering the teaching of the two references together one could say that the references teach a fuel filter (Kasten ‘681, element 14) comprising at least one fuel inlet (Kasten ‘681, element 26), at least one fuel outlet (Kasten ‘681, element 28), a means for separating water from the fuel (Kasten ‘505, elements 32, 34, 36, 50), at least one sump (Kasten ‘505, element 16) for collecting the water separated from the fuel, a water outlet (at the bottom of the sump) associated with the sump, and control means (an automatic water drain control valve - Kasten ‘505, col. 1, l. 66) for the water outlet.

The sump line 34 of Kasten ‘681 can be said to be “mounted onto” the fuel filter downstream of the water outlet. However, Kasten ‘681 does not teach that the “container” 16

“is mounted on the filter housing” as recited in claim 18. To the contrary, Kasten ‘681 teaches that the water discharge device 16 is separated from the separator unit 14 by a long line 34. In contrast, in applicants’ invention, the filter body is located directly on the housing of the fuel filter. In other words, the housing 1 of the fuel filter and the filter body 54 form a unit. This concept is embodied in claim 18 by the language, “the container [in which the means for separating contaminants from the water to be drained off from the sump is located] is **mounted on** the filter housing.” It is emphasized that it is the container itself that must be mounted on the filter housing, not a line connected to the container, which is what Kasten ‘681 teaches.

Neither Kasten ‘505 nor Kasten ‘681 teaches the particular elements of applicants’ claim 18 disposed in the manner specifically required by that claim. Therefore, even if it had been obvious to combine the teachings of Kasten ‘505 and Kasten ‘681 in the manner suggested by the examiner, one of ordinary skill would not have arrived at the subject matter defined by claim 18 or any of the claims dependent thereon and neither reference can be said to anticipate claim 18.

New claim 39 requires, inter alia, a means for separating contaminants from the water to be drained off from the sump located directly at the water outlet. New claim 40 requires, inter alia, an absorbent material, placed at the water outlet, which absorbs water carried away from the sump of the fuel filter and holds the water until the water has evaporated. New claim 41 requires, inter alia, a filter body adjoining the control means for cleaning the water drained from the sump.

The “means for separating contaminants from the water to be drained off from the sump” might be read on the device 16 in Kasten ‘681, but not the line 34. The line 34 does not separate contaminants from the water to be drained off from the sump. One end of the line 34 is “directly at the water outlet,” but certainly not the device 16. Thus, claim 39 is not anticipated by Kasten ‘681.

In Kasten ‘681, the device 16 has no absorbent material. Instead, Kasten ‘681, uses a pleated hydrophobic element 50 for separating water from fuel. Thus, claim 40 is not anticipated by Kasten ‘681.

In addition, the device 16 is spaced from the filter housing 14 by the line 34. One end of the line 34 is placed at the water outlet, but not the device 16, and certainly not absorbent material. Thus, for this additional reason, claim 40 is not anticipated by Kasten ‘681.

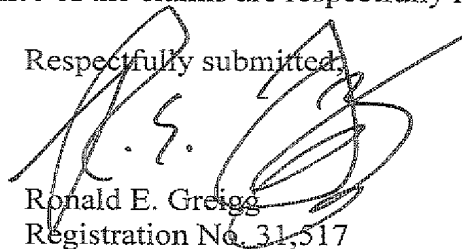
Claim 41 requires a water outlet associated with the sump, a control means for the water outlet and a filter body adjoining the control means for cleaning the water drained from the sump. Kasten ‘681 does not teach “a control means for the water outlet,” but even if it were obvious to include an automatic water drain control valve in Kasten ‘681 as taught in Kasten ‘505, neither reference teaches a filter body adjoining the control means. Two objects are “adjoining” if they are next to or in contact with one another. The device 16 in Kasten ‘681 is not in contact with or next to any valve. To the contrary, the device 16 is spaced from the water outlet 30 by the line 34. Thus, claim 41 is clearly not anticipated by Kasten ‘681.

Appl. No. 10/540,943
Amdt. dated May 11, 2009
Reply to Office action of Nov. 10, 2008

The Commissioner is authorized to charge payment of any/all fees associated with this communication to Deposit Account Number 07-2100.

Entry of the amendment and allowance of the claims are respectfully requested.

Respectfully submitted,



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Attorney of Record
CUSTOMER NO. 02119

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Enclosures: Declarations under 37 CFR 1.131 (4)
 Invention Reports (2) w/translations (2)
 Translations of priority documents (2)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 10/540,943 Confirmation No. 3820
Applicant : Julian DE LA AZUELA et al.
Filed : March 23, 2006
TC/A.U. : 1797
Examiner : T. Lithgow

Docket No. : R.303860-1
Customer No. : 02119

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Date:

DECLARATION UNDER 37 C.F.R. §1.131

Sir:

This declaration is to establish conception of the subject matter of the present application in Germany, a WTO member country, permitted by Rule prior to the effective date of United States Patent Application Publication No. 2003/0121860 A1 filed on 6 December 2002 entitled "Method And Apparatus For Storing Water Separated From Fuel" to Harenbrock et al. (Harenbrock), and diligence to the filing of German Application No. 10261742.2 (constructive reduction to practice) from a time prior to the effective date of the Harenbrock Publication to the priority filing date of the present patent application.

In support of this Declaration, we, Julian De La Azuela, Juergen Gruen and Nestor Rodriguez-Amaya declare and say the following:

That the claimed subject matter of the referenced patent application stands subject to a rejection under 35 U.S.C. 102(e) for anticipation by United States Patent

Application Publication No. 2003/0121860 A1 filed on 6 December 2002 entitled "Method And Apparatus For Storing Water Separated From Fuel" to Harenbrock;

That the claimed subject matter of the referenced, patent application was conceived in Germany before the effective date (6 December 2002) of Harenbrock in the course of my/our employment by Robert Bosch GmbH., the assignee of record at REEL/FRAME 017680/0634;

That the claimed subject matter of the referenced patent application was the subject of an invention report (No. EM 2000/2037) (attached) prepared and submitted with diligence before 6 December 2002 to Mr. Ivo Stute, the assignee's Germany patent attorney, for preparation of the papers necessary for filing an application in Germany;

That the redacted conception date (MPEP 715.07) on the attached invention report (No. EM 2000/2037) is before 6 December 2002, the effective date of Harenbrock;

That a patent specification and drawings were prepared by Mr. Stute on behalf of the assignee based on the subject matter of the invention report (No. EM 2000/2037) and that the patent specification and drawings were reviewed, completed with diligence from a time prior to 6 December 2002, the effective date of Harenbrock, to the filing date of German Application No. 10261742.2, filed on 30 December 2002;

That the instant patent application, filed on 20 November 2003, claims benefits under 35 U.S.C. 119 from German Application No. 10261742.2, filed on 30 December 2002, and that instant patent application contains no new matter relative to German Application No. 10261742.2 from which priority is claimed.

That all statements made herein of my/our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Julian De La Azuela

Date 21.04.09

Juergen Gruen

Date

Nestor Rodriguez-Amaya

Date

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Applicant : Julian DE LA AZUELA et al.
Filed : March 23, 2006
TC/A.U. : 1797
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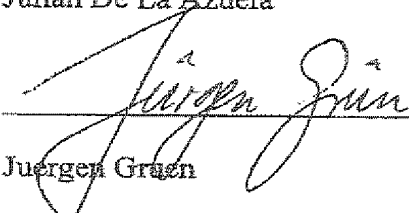
That a patent specification and drawings were prepared by Mr. Stute on behalf of the assignee based on the subject matter of the invention report (No. EM 2000/2037) and that the patent specification and drawings were reviewed, completed with diligence from a time prior to 6 December 2002, the effective date of Harenbrock, to the filing date of German Application No. 10261742.2, filed on 30 December 2002;

That the instant patent application, filed on 20 November 2003, claims benefits under 35 U.S.C. 119 from German Application No. 10261742.2, filed on 30 December 2002, and that instant patent application contains no new matter relative to German Application No. 10261742.2 from which priority is claimed.

That all statements made herein of my/our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Julian De La Azuela

Date

 15.4.2009

Juergen Graen

Date

Nestor Rodriguez-Amaya

Date

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 10/540,943 Confirmation No. 3820
Applicant : Julian DE LA AZUELA et al.
Filed : March 23, 2006
TC/A.U. : 1797
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That the claimed subject matter of the referenced patent application was the subject of an invention report (No. EM 2000/2037) (attached) prepared and submitted with diligence before 6 December 2002 to Mr. Ivo Stute, the assignee's Germany patent attorney, for preparation of the papers necessary for filing an application in Germany;

That the redacted conception date (MPEP 715.07) on the attached invention report (No. EM 2000/2037) is before 6 December 2002, the effective date of Harenbrock;

That a patent specification and drawings were prepared by Mr. Stute on behalf of the assignee based on the subject matter of the invention report (No. EM 2000/2037) and that the patent specification and drawings were reviewed, completed with diligence from a time prior to 6 December 2002, the effective date of Harenbrock, to the filing date of German Application No. 10261742.2, filed on 30 December 2002;

That the instant patent application, filed on 20 November 2003, claims benefits under 35 U.S.C. 119 from German Application No. 10261742.2, filed on 30 December 2002, and that instant patent application contains no new matter relative to German Application No. 10261742.2 from which priority is claimed.

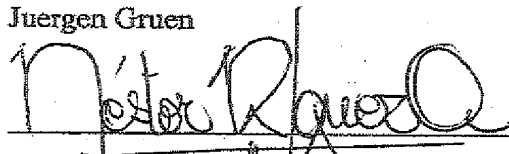
That all statements made herein of my/our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Julian De La Azuela

Date

Juergen Gruen

Date


Nestor Rodriguez-Amaya

April 23, 2009

Date

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 10/540,943 Confirmation No. 3820
Applicant : Julian DE LA AZUELA et al.
Filed : March 23, 2006
TC/A.U. : 1797
Examiner : T. Lithgow

Docket No. : R.303860-1
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Date: May 10, 2009

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In support of this Declaration, I, Ivo Stute, the undersigned German patent attorney, declare and say the following:

That in the second half of year 2002, Robert Bosch GmbH asked me to prepare patent applications on the basis of six different inventor reports. I was asked to provide Robert Bosch GmbH with the specifications for the patent applications, and the applications were planned to be filed by Robert Bosch GmbH itself;

That I received the first two of the six orders at the beginning of August 2002 (one of which being based on inventor's report EM 2002/0417 of Mr. de la Azuela, my docket No. 390/02001) and the other four orders between November 14 and November 25, 2002, including the order letter regarding the inventor report EM 2000/2037 of Mr. Rodriguez-Amaya and Mr. Gruen, which I received on November 25, 2002 (my docket No. 390/02006);

That the intention of Robert Bosch GmbH was to file each of the patent applications before the end of 2002. Therefore, I was asked to provide Robert Bosch GmbH with the specifications for the applications not later than December 17, 2002, well before the holiday time between Christmas Eve and New Year;

That I was not able to comply with this request for these applications, since there was other work I had to deal with. Thus, Robert Bosch GmbH gave its consent for some of the patent applications to be filed with the German Patent and Trademark Office directly through my office until the end of the year. Consequently, I filed the German patent application DE 10261 742.2, the priority of which is claimed in US 10/540,943, on December 30, 2002;


That regarding inventor's report EM 2002/0417, a first draft specification on the basis of this inventor report was sent to Robert Bosch GmbH on November 14, 2002, and a final draft on December 12, 2002;

That I was asked by Robert Bosch GmbH whether it would be useful to combine the inventions reported in EM 2000/2037 and EM 2002/0417 in one application since being closely related to each other;


That, subsequently, I revised the final draft of December 12 regarding EM 2002/0417, incorporated the information of EM 2000/2037 into this draft, adapted the set of claims and filed the finalized application with the German Patent and Trademark Office on December 30, 2002, without making contact with the inventors, Mr. Rodriguez-Amaya and Mr. Gruen. On January 2, 2003, I sent my report about the filing of the patent application to Robert Bosch GmbH. On the same date, I also sent a copy of the application to the inventors Mr. Rodriguez-Amaya and Mr. de la Azuela asking them to review the specification and to provide me with their comments. I also asked Mr. Rodriguez-Amaya to forward the application to Mr. Gruen for reviewing the application as well;

That on the same date of December 30, 2002, I filed a patent application for the order received on November 14, 2002, and on December 31, 2002, I filed a patent application for the order received on November 15, 2002, which was handled in my office under docket No. 390/02004;

That all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



Ivo Stute



Date

Invention Report* to ZGE4 (Location: Fe)

Invention Report No. 2000/2037

From Néstor Rodríguez-Amaya Department: k5/esk5

Title of the invention: Method for dewatering diesel fuel filters and auxiliary devices pertaining thereto

1. Creation:

1.1. Is the invention in your field of employment? ☒ No

1.2. Who assigned you to handle this (supervisor, another department, team task, customer, noone)?

Another department

1.3. Reason for taking up this them (project, guideline, advertising)?

Improving function and quality

1.4. Did this build on prior in-house knowledge/previous work/product knowledge?

☒ Yes

1.5. Was in-house help used (such as patterns, materials, computers, labor)? ☒ No

1.6. Was the invention created within a team? ☒ No

1.6.Is the invention part of a publicly subsidized project? ☒ No

1.7.Inventors:

Name	Employer	Share in %
Jürgen Grün	Robert Bosch GmbH	50%
Néstor Rodríguez-Amaya	Robert Bosch GmbH	50%

2. The description of the invention (appended) must include the following:

2.1. Prior art (what products/suggestions, including from the literature, are being improved?)

2.2. Object of the invention; what deficiencies in the prior art are overcome?

2.3. Summary and advantages of the invention, especially over what is already known?

By means of what the invention proposes, the aforementioned disadvantages are to be eliminated.

2.3 Summary and advantages of the invention

By the method and auxiliary devices proposed in section 2.4, **automatic dewatering of the fuel filter** is attained, which depending on the design either

- entirely avoids posttreatment of the water extracted from the fuel filter, or
- by collecting, cleaning and/or evaporation of the water in a replaceable extra tank assures **environmentally nonpolluting disposal**.

2.4 Detailed description of the invention

A **method for dewatering diesel fuel filters** is proposed, which is intended to happen in accordance with flow chart 2.

Water level gauge (Appendix 1)

From the flow chart it can be seen that it is necessary to detect the minimum water level. The following is therefore proposed as the subject of this invention:

Equipping the diesel fuel filter with the capability of detecting a minimum and a maximum water level. This should be done by providing that either

- one sensor each for the minimum and maximum water levels is built into the water chamber of the filter housing, or
- a single sensor is used, which as described in section 2.2 again makes use of the conductivity of the water and has contacts for detecting the maximum water level. In addition, it is equipped with contacts for detecting the minimum water level. So that the latter contacts are not subjected to electric current, it is proposed that electrical circuitry of the kind shown in Appendix 2 be used, or
- the different optical index of refraction of water and fuel is used. With the aid of transmitters and receivers, for instance, the transition between the two fluids is detected and thus the minimum and maximum water levels are detected.

Water extraction (Appendixes 3, 4)

When the maximum water level is reached, the water should be extracted from the filter housing.

For that purpose, in addition to what is already known, the following is proposed:

- Actuation of a suitable valve by means of a float. This actuation can be done directly, in that when the maximum water level is reached the float carries the valve cone with it,

- 2.4. Detailed description of the makeup and function of what is proposed, with possible alternatives.
- 2.5. Drawing (block circuit diagram, mechanical structure, graph)
- 2.6. Can the invention be well documented from the product (if not, what argues for a patent application)?

(signed) Rodríguez

Appended items:

Invention description and drawing(s) – total number 14 pages (each in duplicate)

*Invention reports are to be submitted solely to Robert Bosch GmbH, Department ZGE4. Robert Bosch is entitled by the TOGE to handle inventions in its own name and to issue legally binding declarations thereon.

Method for dewatering diesel fuel filters and auxiliary devices pertaining thereto

2.1 Prior art

Diesel fuel filter with water collection container, water level gauge, and water extractor

2.2 Object of the invention

Although the diesel fuel is produced in water-free form in the refinery, it comes into contact with water in various ways. For instance, the water in the air (moisture) condenses in the fuel storage tank, so that when the fuel tank of diesel vehicles is filled, water is introduced into the tank with the fuel.

Some of this water is taken up by the fuel in solution. This proportion is dependent on the temperature. The other part, because of its higher specific weight, settles on the bottom of the fuel tank or is fed with the fuel into the injection equipment. The proportion of water entrained with the fuel is precipitated out because of the varying surface tension in the fuel filter and settles on the bottom of the fuel filter housing. There, it has to be removed at defined intervals – **dewatering of the diesel fuel filter**, in order to avoid damage to the fuel injection equipment.

Some diesel fuel filters are equipped with so-called water level sensors. These sensors as a rule comprise two contacts, insulated from one another, that are subjected to electric current because of the increased conductivity of the water. A warning light is thereupon activated, which signals to the vehicle driver the necessity of evacuation or dewatering.

The same fuel filters are equipped with a manually actuated evacuation valve. The practice at present is for the water to be drained off by opening this valve while the vehicle is stopped, until pure fuel flows out of the filter housing.

The course of this entire operation can be seen from flow chart 1.

The operation described above has the following **disadvantages**:

- Often, for many reasons, the driver ignores the warning light, with the potential danger of damage to the injection system.
- Contaminated water and fuel can be drained off into the open, accordingly polluting the environment.

or indirectly, in that the flow lifts the valve cone from its seat by leverage. In both cases, a suitable stoppage, not shown, of the closure of the valve only once the minimum water level is reached should be assured. This mode of operation can also be attained by providing that a bimetal or a memory metal, as shown in Appendix 3, is actuated electrically in the evacuation phase.

Alternative to this, it is proposed (see Appendix 4) that a valve be used, which:

- is actuated electromagnetically, or
- is closed via a spring and opened via a memory metal element, or
- is closed via a spring and opened via a bimetal.

Water disposal (Appendixes 5-6)

For water disposal, there are two alternatives, as shown in flow chart 2:

- a) separation of water and contaminants with or without a filter and evaporation of the water with or without an extra tank.

For this purpose, the following are proposed:

- in the outlet of the fuel filter, installing a suitable active filter, which traps the contaminants and allows clean water to escape,
- equipping the fuel filter housing with an open extra chamber, into which the water flowing out of the filter is carried via a suitable active filter, which traps the contaminants and allows the cleaned water to escape into the environment through the opening – evaporation/drainage – or
- attaching a separate extra tank with the same function, or
- equipping the fuel filter housing with an extra chamber, which is filled with chemicals that bind the contaminants. The water can evaporate either freely or with the support of heating elements, or
- attaching a separate extra tank with the same function, or
- attaching a separate extra tank which enables the evaporation of the water and traps the contaminants that settle on the bottom.

Care must be taken to assure environmentally nonpolluting disposal of the residues.

- b) Evaporation of the water and combustion of the contaminants using the jet pump principle, in that the water, as known from various applications, is introduced via

a suitably designed nozzle opening into the intake or suction tract of the engine (Appendixes 7 and 8). As a result of this method, separation and posttreatment of the contaminants is unnecessary.

Method for dewatering diesel fuel filters and auxiliary devices pertaining thereto

Flow chart 1 [top to bottom]

Dewatering of diesel fuel filters

Settle water out

Detect water level

Activate warning light

Open outlet valve

Is fuel running out of the system? ---- No

Yes

Close outlet valve

End

Method for dewatering diesel fuel filters and auxiliary devices pertaining thereto

Flow chart 2 [top to bottom]



Appendix 1 Water level gauge

Utilizing different conductivity

Utilizing different index of refraction

Sensors

Sensor for detecting maximum and minimum water level

Appendix 2 Electrical circuitry

- (1) Contact for maximum water level
- (2) Contact for minimum water level
- (3) Relay
- (4) Bimetal

Function:

- Contact (2) is short-circuited when a minimum water level is reached, but remains inoperative because of the disconnection of the relay.
- Contact (1) is short-circuited when a maximum water level is reached; the relay is then energized and closes its contacts.
- The bimetal element (4) is consequently energized and actuates the outlet cross section; water can run out of the filter.
- When a minimum water level is reached, contact (2) is opened, the relay stops receiving current and opens its contacts; the bimetal element consequently stops receiving current, and the outlet cross section is closed. -> End of water extraction.

Appendix 3 Water extraction

Float

Bimetal or alternatively memory metal

Appendix 4 Water extraction

[left to right:]

Magnet valve

Spring Memory metal

Spring Bimetal

Spring Memory metal or bimetal

Appendix 5 Water disposal

Appendix 6 Water disposal

[left to right:]

Filter

H₂O + contaminants chemically bound

Heating elements for evaporation

Free evaporation

Appendix 7 Water disposal

Appendix 8 Water disposal

Erfindungsmeldung* an ZGE4 (Standort Fe)**EM-Nr.** 2000/2037

Absender: rodriguez - amaya, néstor k5/esk5 45201
 (Name, Vorname) (Abteilung) (Telefon/Fax)

Bezeichnung der Erfindung: Methode zur Entwässerung von Dieselmotorkraftstofffiltern
und dazugehörige Hilfsvorrichtungen

bzw. ☐ Ergänzung zu EM-Nr./Anmeldung-Nr. _____

Wichtig: Bitte vollständig ausfüllen!

1. Zur Entstehung:

- 1.1. Betrifft die Erfindung Ihr Arbeitsgebiet? ja ☐ nein ☒
 1.2. Wer gab Auftrag zur Bearbeitung (Vorgesetzter, andere Abt., Teamaufgabe, Kunde, niemand)?
andere Abt.

- 1.3. Anlaß, das Thema aufzugreifen (Projekt, Richtlinie, Reklamation)?
Funktions und Qualitätsverbesserung

- 1.4. Wurde auf betrieblichen Vorkenntnissen/Vorarbeiten/Produktkenntnissen aufgebaut?
 1.5. Wurden betriebliche Hilfsmittel benutzt (z.B. Muster, Stoffe, Rechner, Labor)?
 1.6. Ist die Erfindung in einem Team - z.B. Wertgestaltung - entstanden?
 1.7. Liegt die Erfindung im Rahmen eines öffentlich geförderten Projekts?
 1.8. Erfinder:

Zentralstelle ZG...

Bearbeiter, Tel.

My. 33124

EZ-Klasse

0495

Verteiler

K5/EAP

1 ESK

Inanspruchnahme

erl. am

Ansprechpartner für ZGE

(bei mehr als einem Erfinder)

Bitte Daten unbedingt vollständig eintragen!

Personalnummer	Name, Vorname	Telefon	GB/Abt.	Standort	Arbeitgeber	Stellung im Haus	Anteil %
1 261 064	Grün, Jürgen	31 951	K5/EAP2	Fe	RB GmbH	Sachbearbeiter	50 %
0 426 320	rodriguez-amaya, néstor	45 201	K5/ESK5	Fe	RB GmbH	Fachreferent	50 %

2. Die Wiedergabe der Erfindung (Anlage) muß enthalten (Hinweise siehe Rückseite):

- 2.1. Stand der Technik (welche Produkte/Vorschläge auch aus der Literatur werden verbessert?)
 2.2. Aufgabe der Erfindung; welche Mängel zum Stand der Technik werden behoben?
 2.3. Kern und Vorteile der Erfindung, besonders gegenüber dem Bekannten?
 2.4. Detaillierte Beschreibung von Aufbau und Funktion des Vorschlages mit möglichen Alternativen.
 2.5. Zeichnung (Blockschaltbild, mech. Aufbau, Diagramm)
 2.6. Ist die Erfindung am Erzeugnis gut nachweisbar (wenn nein, was spricht für eine Anmeldung)?

(Unterschrift)

Anlagen

Erfindungsbeschreibung und Zeichnung(en) - Gesamtzahl 14 Blatt (je 2fach)

* Erfindungsmeldungen sind ausschließlich an die Robert Bosch GmbH (RB), Abt. ZGE4 einzureichen. RB ist von den TOGE ermächtigt, Erfindungen im eigenen Namen zu bearbeiten und rechtlich verbindliche Erklärungen dazu abzugeben.

2.1 Stand der Technik

Dieselmotorkraftstofffilter mit Wassersammelbehälter, Wasserstandanzeige und Wasserentnahmeverrichtung.

2.2 Aufgabe der Erfindung

Obwohl der Dieselmotorkraftstoff in den Raffinerien wasserfrei hergestellt wird, kommt dieser mit Wasser auf verschiedenen Arten in Kontakt. Beispielsweise kondensiert das in der Luft vorhandene Wasser im Kraftstoffaufbewahrungsbehälter (Feuchtigkeit), so dass beim Befüllen der Kraftstoffbehälter von Dieselfahrzeugen auch Wasser mitbefüllt wird.

Ein Teil dieses Wassers wird vom Kraftstoff in Lösung aufgenommen. Dieser Anteil ist von der Temperatur abhängig. Der andere Teil setzt sich auf Grund seines höheren spezifischen Gewichtes zum Teil am Boden des Kraftstoffbehälters ab oder wird mit dem Kraftstoff in die Einspritzausrüstung befördert. Der vom Kraftstoff mitgeführte Wasseranteil wird wegen der unterschiedlichen Oberflächenspannung im Kraftstofffilter ausgeschieden und setzt sich am Boden des Kraftstofffiltergehäuses ab. Dort muß er in bestimmten Zeitabständen herausgenommen werden - **Entwässerung des Dieselmotorkraftstofffilters**, um Schaden in der Kraftstoffeinspritzausrüstung zu vermeiden.

Einige Dieselmotorkraftstofffilter sind mit sogenannten Wasserstandssensoren ausgerüstet. Diese bestehen in der Regel aus zwei untereinander isolierten Kontakten, die durch die erhöhte Leitfähigkeit des Wassers unter Strom gesetzt werden. Daraufhin wird eine Warnlampe aktiviert, die dem Fahrzeugführer die Notwendigkeit der Entleerung bzw. Entwässerung signalisiert.

Selbige Kraftstofffilter sind mit einem manuell betätigten Entleerungsventil ausgestattet. Gängige Praxis ist, dass das Wasser im Stillstand des Fahrzeuges durch das Öffnen dieses Ventils abgelassen wird bis reiner Kraftstoff aus dem Filtergehäuse herausströmt. Der Ablauf dieses gesamten Vorgangs kann entsprechend dem Ablaufdiagramm 1 wiedergegeben werden.

Der oben beschriebene Vorgang hat folgende **Nachteile**:

- Des öfteren wird, aus vielerlei Gründen, die Warnlampe ignoriert, mit der potentiellen Gefahr von Beschädigungen des Einspritzsystems,
- Kontaminiertes Wasser und Kraftstoff können ins freie abgelassen werden mit entsprechender Verschmutzung der Umwelt.

Durch den Vorschlag der Erfindung sollen oben erwähnte Nachteile abgestellt werden.

2.3 Kern und Vorteile der Erfindung

Durch die im Punkt 2.4 vorgeschlagene Methode und Hilfsvorrichtungen ist eine **automatische Entwässerung des Kraftstofffilters** gegeben, die, je nach Auslegung,

- gänzlich die Nachbehandlung des aus dem Kraftstofffilter entnommenen Wassers vermeidet, oder
 - durch das Sammeln, Reinigen und/oder Ausdünsten des Wassers in einen austauschbaren Zusatzbehälter
- eine **umweltfreundliche Entsorgung** gewährleistet.

2.4 Beschreibung der Erfindung

Es wird eine Methode zur Entwässerung von Dieselkraftstofffiltern vorgeschlagen, die nach dem Ablaufdiagramm 2 geschehen soll.

Wasserstandsniveauanzeige [WSN] (Anhang 1)

Aus dem Ablaufdiagramm ist ersichtlich, daß das Erkennen des minimalen WSN notwendig ist. Daher wird als Gegenstand dieser Erfindung vorgeschlagen:

Das Dieselkraftstofffilter mit der Möglichkeit der Erkennung eines minimalen und eines maximalen Wasserstandniveaus auszustatten. Dies soll dadurch erfolgen, daß entweder:

- je ein Sensor für das minimale und das maximale WSN in die Wasserkammer des Filtergehäuses eingebaut wird, oder
- ein einziger Sensor verwendet wird, der, wie unter Punkt 2.2 beschrieben, wiederum die Leitfähigkeit des Wassers ausnutzt und Kontakte für die Erfassung des maximalen WSN besitzt. Zusätzlich ist er mit Kontakten für die Erfassung des minimalen WSN ausgestattet. Damit letztere Kontakte nicht ständig unter Strom stehen, wird vorgeschlagen eine elektrische Beschaltung, wie im Anhang 2 gezeigt, zu verwenden, oder
- der unterschiedliche optische Brechungsindex zwischen Wasser und Kraftstoff ausgenutzt wird. Dabei soll mit Hilfe von z.B. Sendern und Empfängern der Übergang der beiden Flüssigkeiten detektiert und damit das min. und max. WSN zu erfasst werden.

Wasserentnahme (Anhang 3,4)

Beim Erreichen des maximalen WSN soll das Wasser aus dem Filtergehäuse entnommen werden.

Hierfür wird zusätzlich zur bekannten Lösung folgendes vorgeschlagen:

- Betätigen eines geeigneten Ventils mittels eines Schwimmers. Diese Betätigung kann direkt erfolgen, dadurch, dass beim Erreichen des maximalen WSN der Schwimmer den Ventilkegel mitnimmt, oder indirekt, dadurch, dass der Schwimmer über Hebelwirkung den Ventilkegel aus seinem Sitz hebt. In beiden Fällen soll eine geeignete, nicht gezeigte Arretierung das Verschließen des Ventils erst nach Erreichen des min. WSN gewährleisten. Diese Wirkungsweise kann auch dadurch erreicht werden, dass ein Bimetall oder ein memory-metal, wie in Anhang 3 gezeigt, in der Phase der Entleerung elektrisch betätigt wird.

Alternativ hierzu wird vorgeschlagen (vgl. Anhang 4), ein Ventil einzusetzen, daß:

- elektromagnetisch betätigt wird, oder
- über eine Feder geschlossen und über memory-metal-Element geöffnet wird, oder
- über eine Feder geschlossen und über Bimetall geöffnet wird.

Methode zur Entwässerung von Kraftstofffiltern und dazugehörige Hilfsvorrichtungen

Wasserentsorgung (Anhang 5-6)

Für die Wasserentsorgung ergeben sich, wie im Ablaufdiagramm 2 gezeigt, zwei Alternativen:

- a) Trennung von Wasser und Verunreinigungen mit/ohne Filter und Verdunstung/Verdampfung des Wassers mit/ohne Zusatzbehälter.

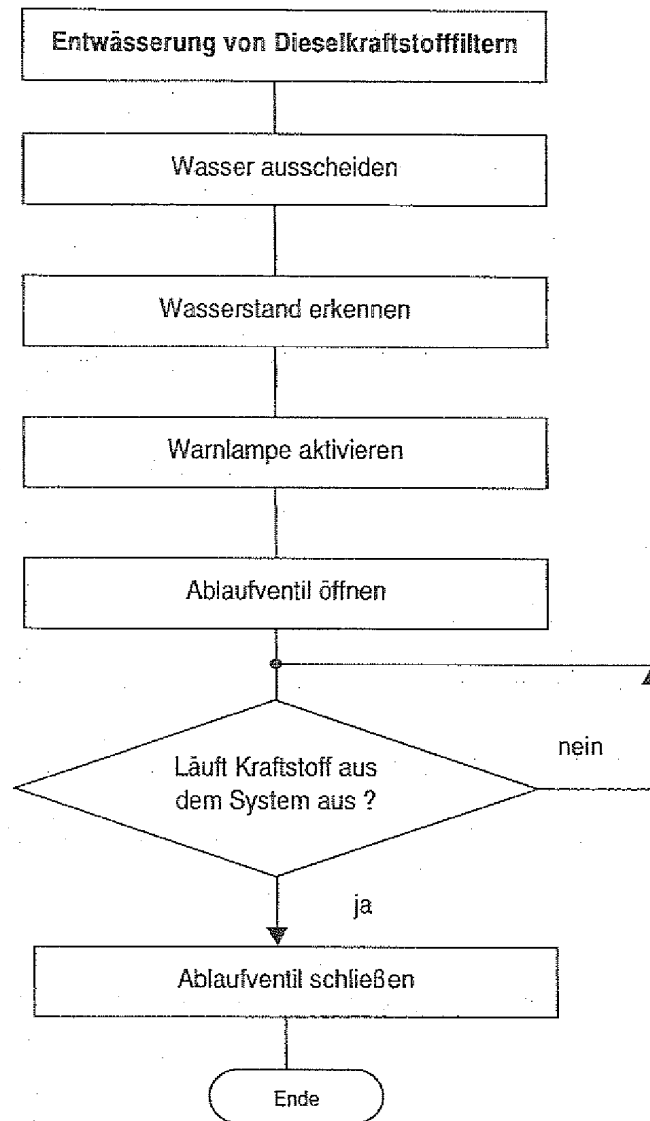
Hierzu wird vorgeschlagen:

- In den Ablauf des Kraftstofffilters ein geeignetes Aktivfilter anzubauen, das die Verunreinigungen zurückhält und reines Wasser entweichen läßt, oder
- das Kraftstofffiltergehäuse mit einer offenen Zusatzkammer auszustatten, in die das aus dem Filter abfließende Wasser über ein geeignetes Aktivfilter durchgeleitet wird, welches die Verunreinigungen zurückhält und das gereinigte Wasser durch die Öffnung in die Umwelt entweichen läßt - Verdunstung/Abfließen, oder
- einen separaten Zusatzbehälter mit der gleichen Funktion anzubringen, oder
- das Kraftstofffiltergehäuse mit einer Zusatzkammer auszustatten, die mit Chemikalien gefüllt wird, welche die Verunreinigungen binden. Das Wasser kann entweder frei oder durch Heizelemente unterstützt verdunsten, oder
- einen separaten Zusatzbehälter mit der gleichen Funktion anzubringen, oder
- einen separaten Zusatzbehälter anzubringen, welcher die Verdunstung des Wassers ermöglicht und die Verunreinigungen, die sich am Boden absetzen, zurückgehalten.

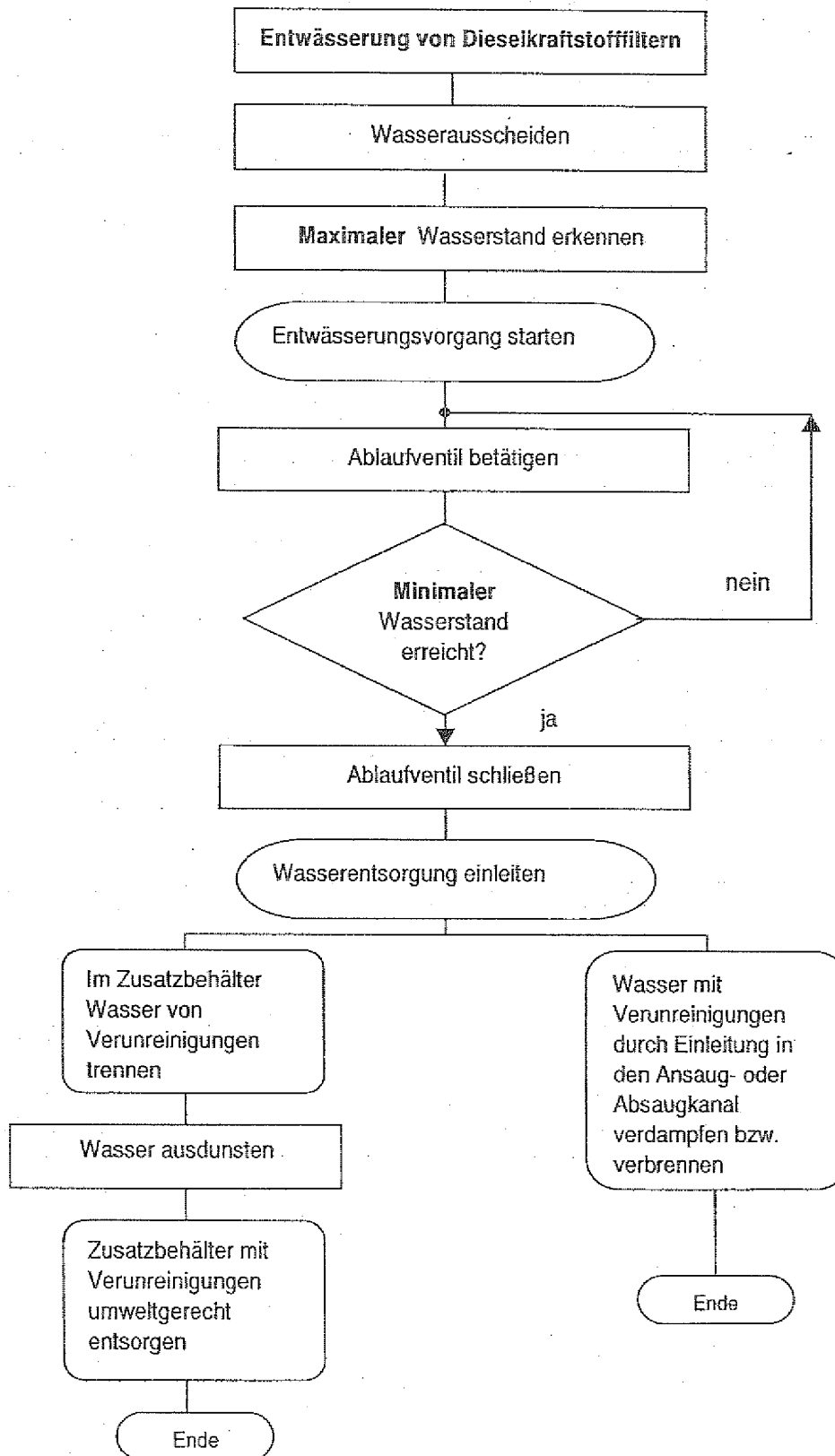
Für umweltgerechte Entsorgung der Restbestände muß gesorgt werden.

- b) Verdampfung von Wasser und Verbrennung der Verunreinigungen unter Benutzung des Strahlpumpenprinzips, indem das Wasser, wie aus verschiedenen Anwendungen bekannt, über eine geeignet ausgelegte Düsenöffnung in den Ansaug- oder in den Absaugtrakt des Motors eingeleitet wird (Anhang 7 und 8). Durch diese Methode ist eine Trennung und Nachbehandlung der Verunreinigungen hinfällig.

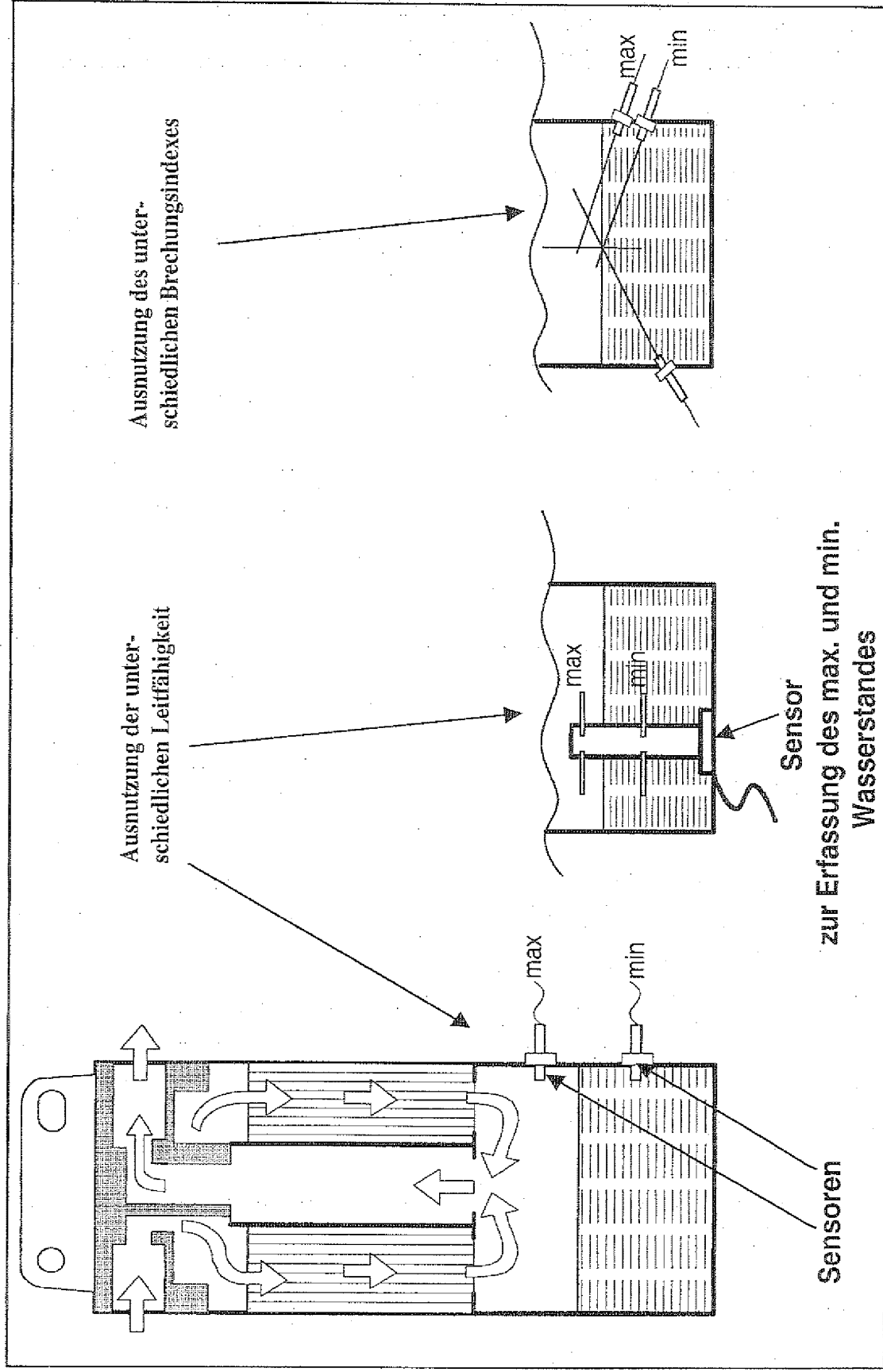
Ablaufdiagramm 1



Ablaufdiagramm 2



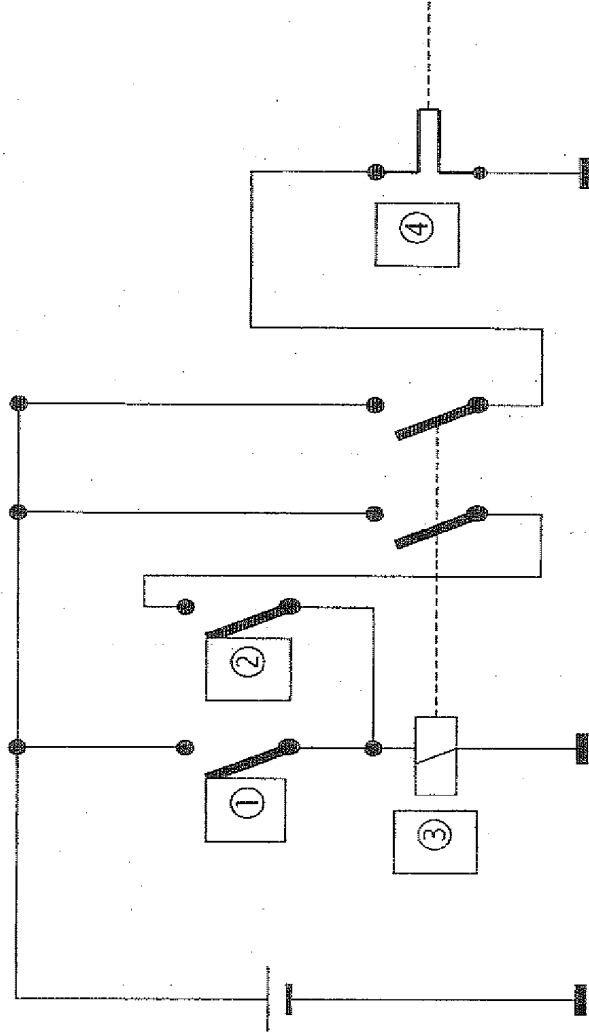
Anhang 1 Wasserstandsanzeige



Anhang 2 elektrische Beschaltung

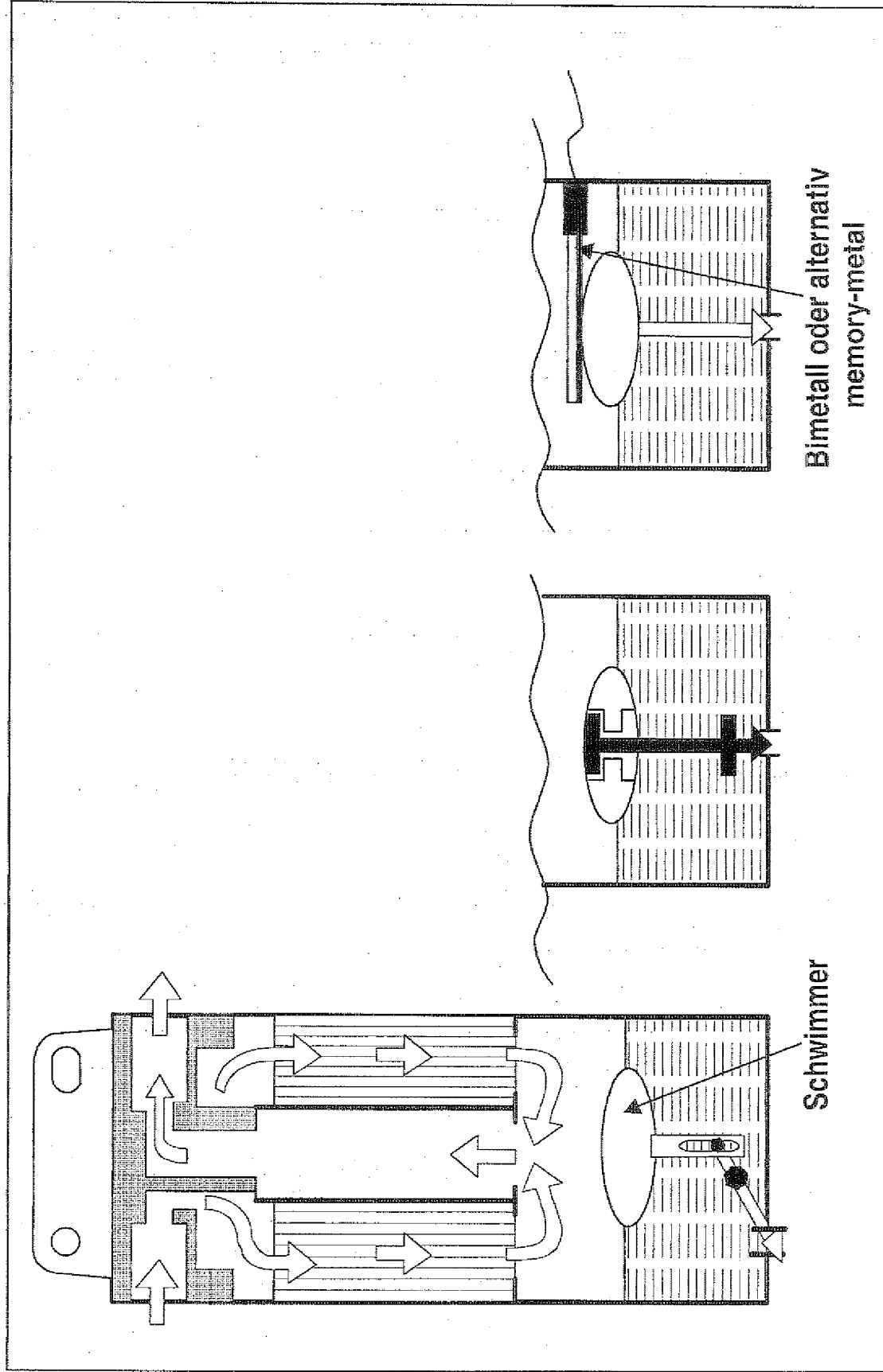
Funktion:

- Kontakt ② wird beim Erreichen eines minimalen Wasserniveaus kurzgeschlossen, bleibt aber durch die Trennung des Relaiskontaktes ohne Wirkung.
- Kontakt ① wird beim Erreichen eines maximalen Wasserniveaus kurzgeschlossen; das Relais wird dann bestromt und schließt seine Kontakte. Das Bimetallelement ④ wird infolge bestromt, betätigt den Ablaufquerschnitt, Wasser kann aus dem Filter herauslaufen.
- Beim Erreichen eines minimalen Wasserniveaus wird Kontakt ② aufgemacht, das Relais wird entstromt und öffnet seine Kontakte, das Bimetallelement wird infolge entstromt und der Ablaufquerschnitt wird geschlossen → Ende der Wasserentnahme

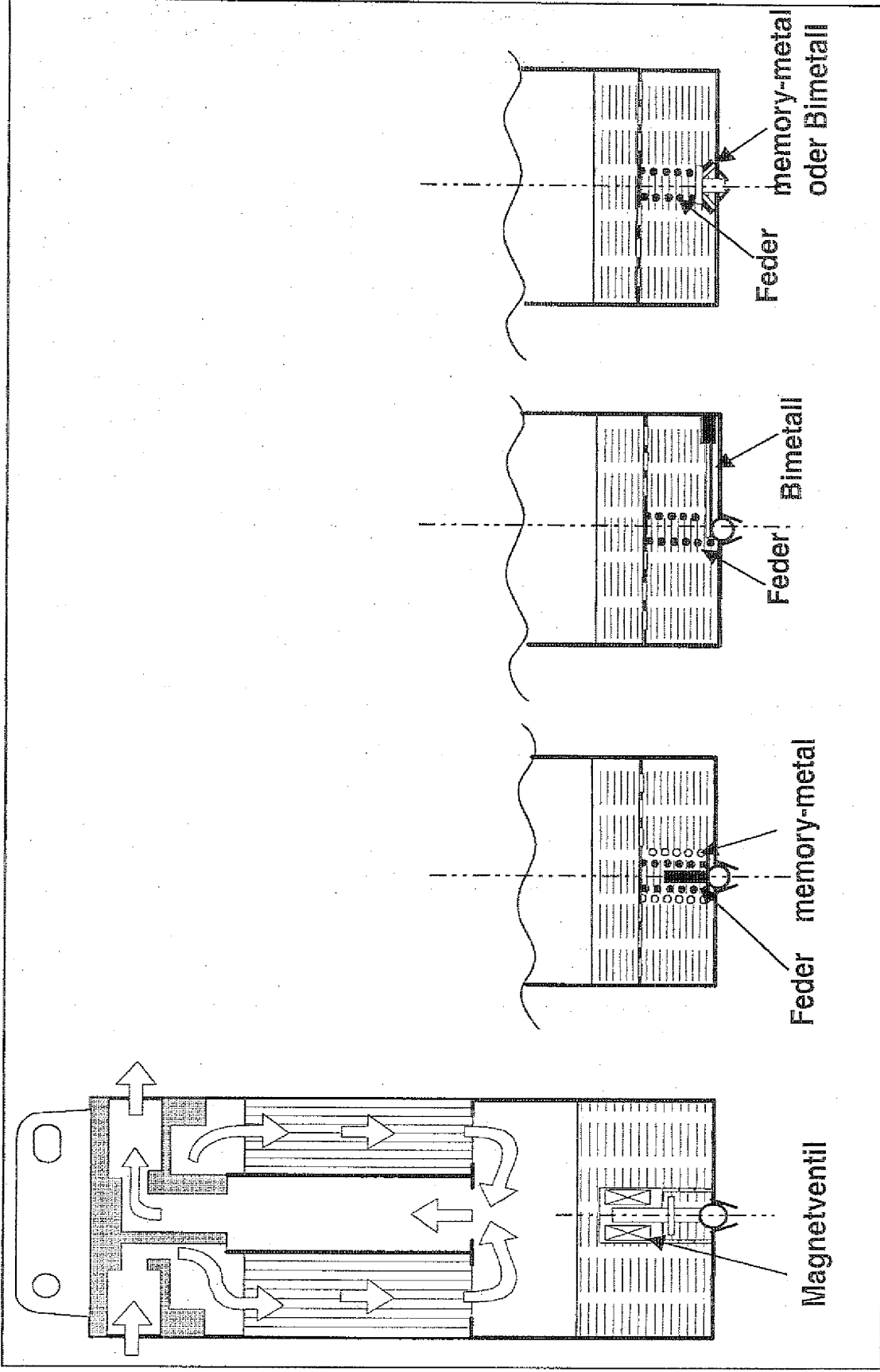


- ① Kontakt max. Wasserniveau
- ② Kontakt min. Wasserniveau
- ③ Relais
- ④ Bimetall

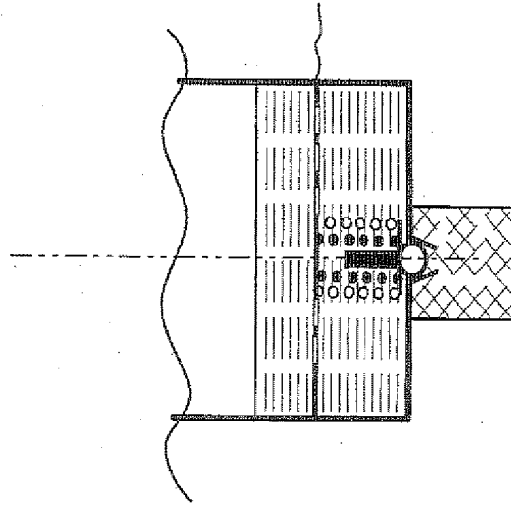
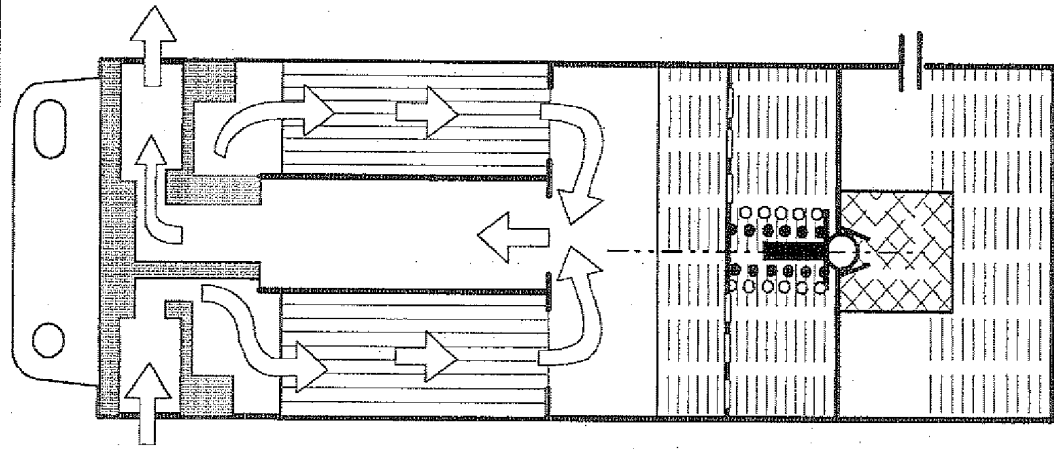
Anhang 3 Wasserentnahme



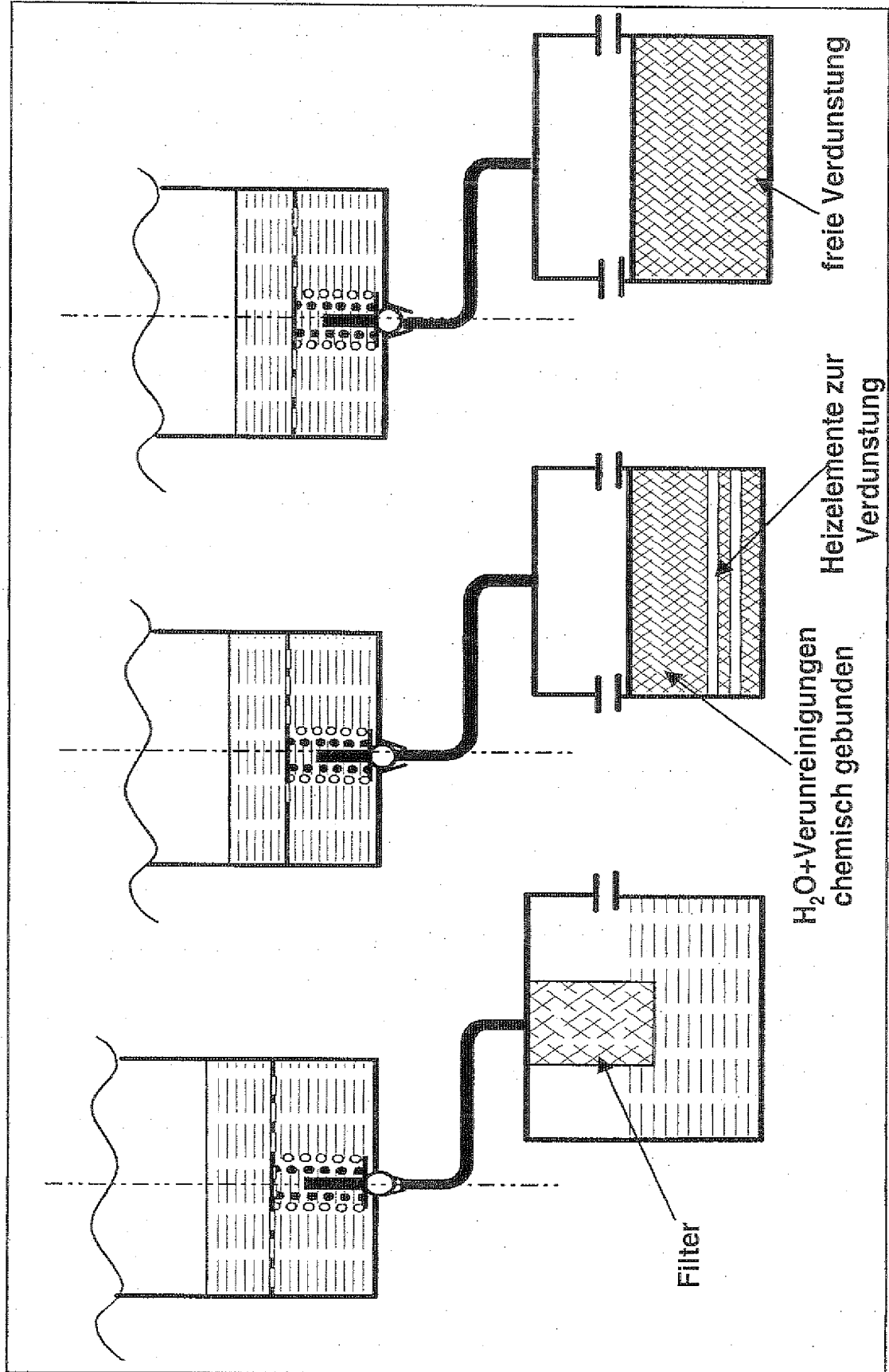
Anhang 4 Wasserentnahme



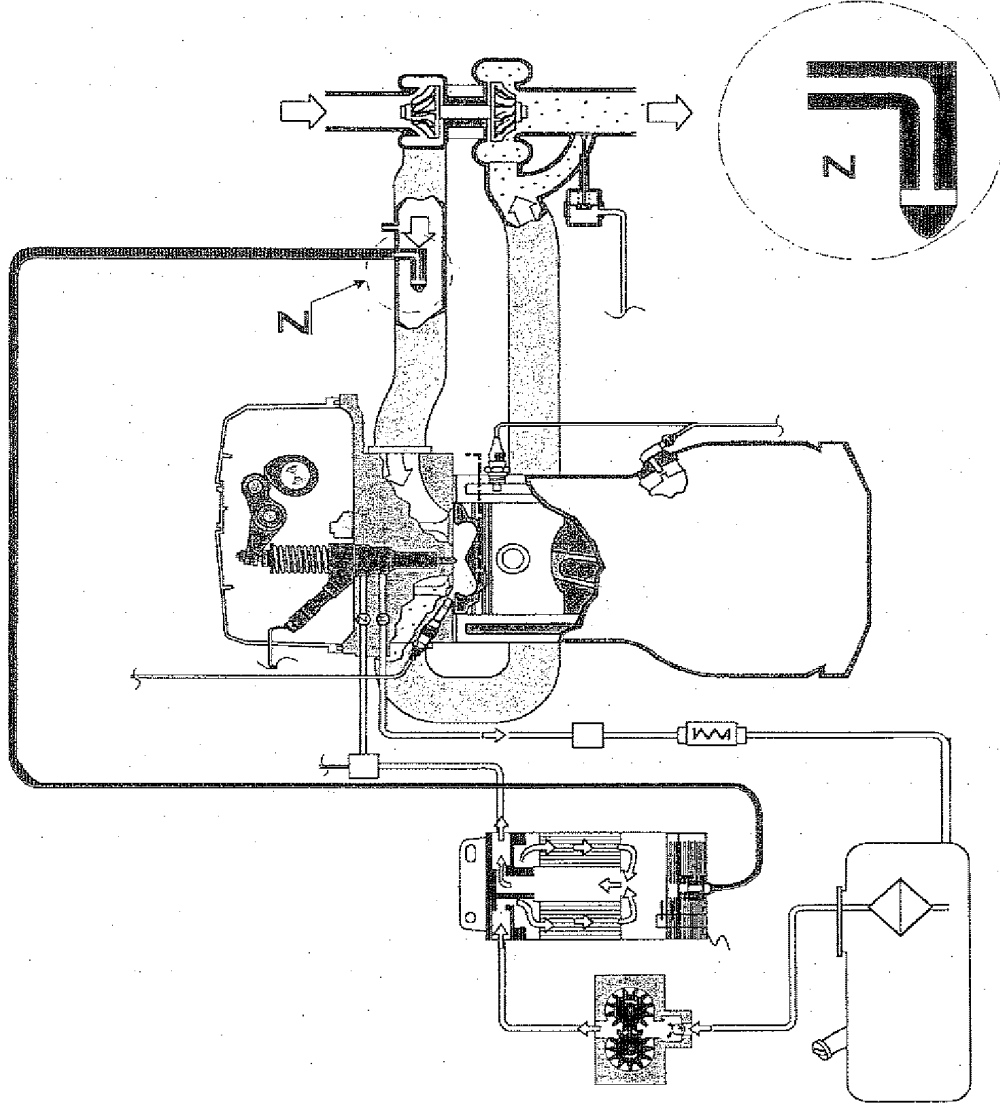
Anhang 5 Wasserentsorgung



Anhang 6 Wasserentsorgung



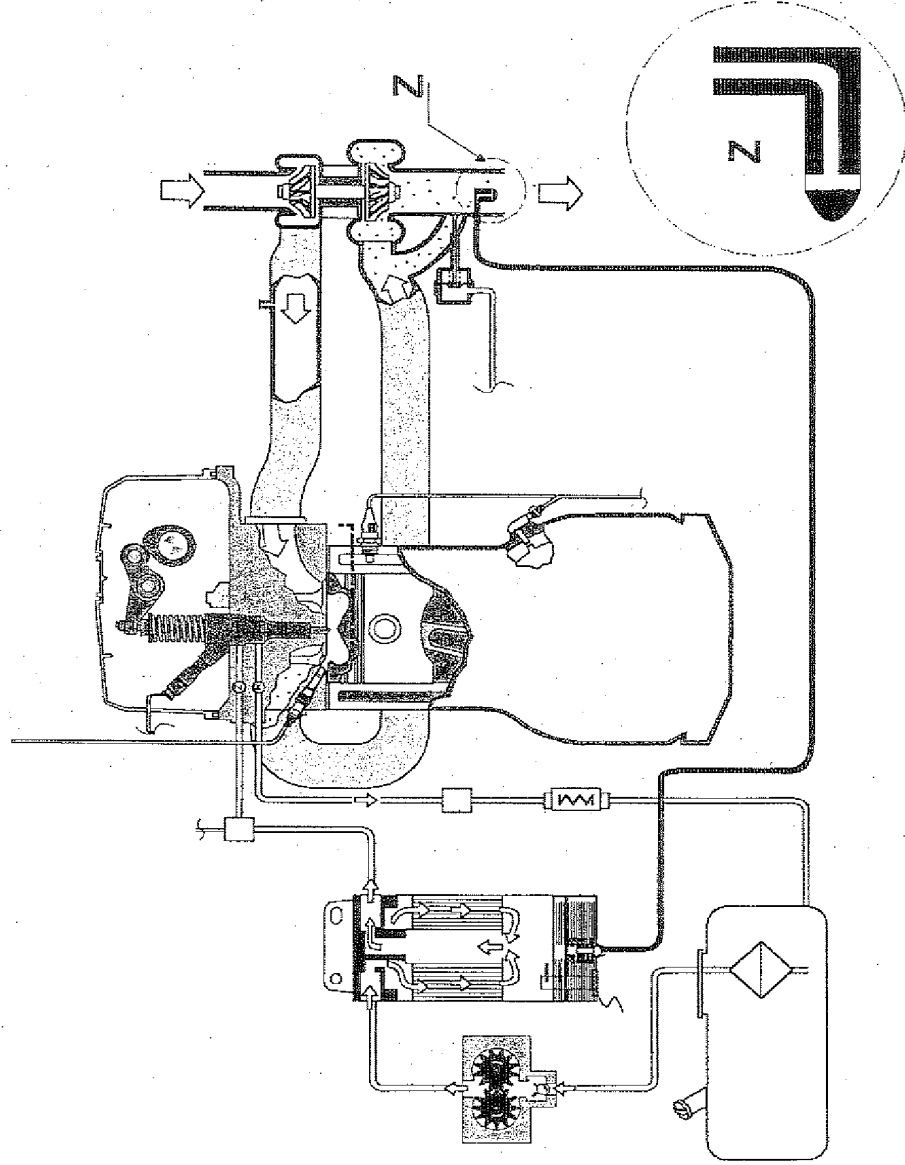
Anhang 7 Wasserentsorgung



BOSCH 

K5/ESK5-rodriquez
K5/EAP2-Grün

Anhang 8 Wasserentsorgung



BOSCH 

K5/ESK5-rodriquez
K5/EAP2-Grün

Invention Report* to ZGE4 (Location: Fe)

Invention Report No. 2002/0417

From Alfonso Baz y Baz Department: GS-FI/WG

Title of the invention: Water management system

1. Creation:

1.1. Is the invention in your field of employment? ☒ Yes

1.2. Who assigned you to handle this (supervisor, another department, team task, customer, noone)?

Team task

1.3. Reason for taking up this them (project, guideline, advertising)?

Project

1.4. Did this build on prior in-house knowledge/previous work/product knowledge?

☒ Yes

1.5. Was in-house help used (such as patterns, materials, computers, labor)? ☒ Yes

1.6. Was the invention created within a team? ☒ Yes

1.6. Is the invention part of a publicly subsidized project? ☒ No

1.7. Inventor:

Name	Employer	Share in %
Julian de la Azuela	Robert Bosch GmbH	100%

2. The description of the invention (appended) must include the following:

2.1. Prior art (what products/suggestions, including from the literature, are being improved?)

2.2. Object of the invention; what deficiencies in the prior art are overcome?

2.3. Summary and advantages of the invention, especially over what is already known?

2.4. Detailed description of the makeup and function of what is proposed, with possible alternatives.

- 2.5. Drawing (block circuit diagram, mechanical structure, graph)
- 2.6. Can the invention be well documented from the product (if not, what argues for a patent application)?

(signed) Alfonso Baz y Baz

Appended items:

Invention description and drawing(s) – total number 4 pages (each in duplicate)

*Invention reports are to be submitted solely to Robert Bosch GmbH, Department ZGE4. Robert Bosch is entitled by the TOGE to handle inventions in its own name and to issue legally binding declarations thereon.

Erfindungsmeldung* an ZGE4 (Standort Fe)

Absender: Baz y Baz, Alfonso GS-FI/EWG -995
 (Name, Vorname) (Abteilung) (Telefon/Fax)

Bezeichnung der Erfindung: Wassermanagementsystem

Zentralstelle ZG **M3** - **Hq**
 Bearbeiter, Tel. ~~XXXX~~
 EZ-Klasse **0450**
 Verteiler **GS-FI/EWG**
 Inanspruchnahme
 erl. am

Wichtig: Bitte vollständig ausfüllen!

1. Zur Entstehung:

- 1.1. Betrifft die Erfindung Ihr Arbeitsgebiet? ja ☒ nein ☐
 1.2. Wer gab Auftrag zur Bearbeitung (Vorgesetzter, andere Abt., Teamaufgabe, Kunde, niemand)?
Teamaufgabe
 1.3. Anlaß, das Thema aufzugreifen (Projekt, Richtlinie, Reklamation)?
Projekt
 1.4. Wurde auf betrieblichen Vorkenntnissen/Vorarbeiten/Produktkenntnissen aufgebaut? ja ☒ nein ☐
 1.5. Wurden betriebliche Hilfsmittel benutzt (z.B. Muster, Stoffe, Rechner, Labor)?
 1.6. Ist die Erfindung in einem Team - z.B. Wertgestaltung - entstanden?
 1.7. Liegt die Erfindung im Rahmen eines öffentlich geförderten Projekts?
 1.8. Erfinder:

ja ☒ nein ☐
 ja ☒ nein ☐
 ja ☐ nein ☒

Ansprechpartner für ZGE

(bei mehr als einem Erfinder)

Bitte Daten unbedingt vollständig eintragen!

Personalnummer	Name, Vorname	Telefon	GB/Abt.	Standort	Arbeitgeber	Stellung im Haus	Anteil %
1508	de la Azuela, Julián	-997	GS-FI/EWG Alc.		RBEH	Sachbearb.	100

2. Die Wiedergabe der Erfindung (Anlage) muß enthalten (Hinweise siehe Rückseite):

- 2.1. Stand der Technik (welche Produkte/Vorschläge auch aus der Literatur werden verbessert?)
 2.2. Aufgabe der Erfindung; welche Mängel zum Stand der Technik werden behoben?
 2.3. Kern und Vorteile der Erfindung, besonders gegenüber dem Bekannten?
 2.4. Detaillierte Beschreibung von Aufbau und Funktion des Vorschlages mit möglichen Alternativen.
 2.5. Zeichnung (Blockschaltbild, mech. Aufbau, Diagramm)
 2.6. Ist die Erfindung am Erzeugnis gut nachweisbar (wenn nein, was spricht für eine Anmeldung)?

(Ort, Datum)

(Unterschrift)

Anlagen

Erfindungsbeschreibung und Zeichnung(en) - Gesamtzahl 04 Blatt (je 2fach)

* Erfindungsmeldungen sind ausschließlich an die Robert Bosch GmbH (RB), Abt. ZGE4 einzureichen. RB ist von den TOGE ermächtigt, Erfindungen im eigenen Namen zu bearbeiten und rechtlich verbindliche Erklärungen dazu abzugeben.

The watermanagement systems are a combination between three components:

- 1.- Water extraction system
- 2.- Water elimination point
- 3.- Water elimination system

A brief description of the systems below.

1.- Water extraction systems

- 1.- Volumetric pump
- 2.- Centrifugal pump
- 3.- Electronic controled valve + 1 level water sensor
- 4.- Electronic controled valve + 2 level water sensor

2.- Water elimination points

- 1.- Evaporator

3.- Water elimination system

- 1.- Evaporation

4.- Combinations to be protected (patents)

Previous information related to ZGE 4 Erfindungsmeldung Dokument

- Point 2.2.-
- a) Actual solutions affect/need other systems in the car
 - b) Actual system need other parts different to the filter to be mounted in the car
 - c) Actual solutions do not solve the medioambiental problem of dropping water
 - d) Actual systems need maintenance from driver / owner the car

Point 2.3.- a) New system solves all points of point 2.2

Point 2.4 and 2.5.- See below

Point 2.6.- The system is very interesting for our division since it can be mounted in our filters and supplied as a unit to the customer.

The system will protect the injection system against water presence.

The introduction of the system is a project with the customer FIAT

Water extraction systems

1.- Volumetric pump: applicable to suction systems

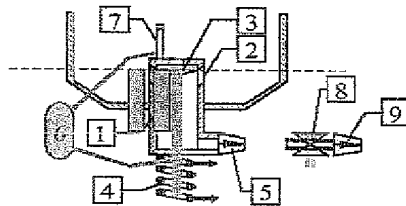


Figura 4.1.1 Diagrama básico del sistema de extracción. (1) cuerpo de la bomba. (2) orificios. (3) pistón. (4) electroimán. (5) válvula anti-retorno. (6) electrónica de control. (7) sensor de agua. (8) electroválvula. (9) válvula anti-retorno.

When signal in water sensor, the magnet will work and then the piston will go down. The volume of water below the line will be pumped to throughout the valve.

The one way valve will open due to the increase of pressure. The pumping action will be fixed by a number of piston strokes. Afterwards the system returns to the initial state.

Element 8 (9 and 5 are equivalent) is an option to increase the security.

An extra security is introduced with the software programmed in the mmed in the platte 6

2.- Centrifugal pump: applicable to suction systems

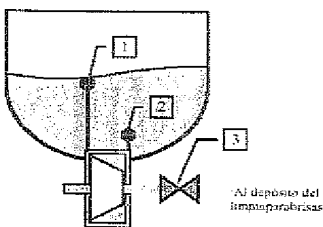


Fig. 4.2.1: Diagrama básico del sistema de extracción. (1, 2) sensores de agua. (3) electroválvula.

When signal in uper water sensor the pump will start.

When signal in lower water sensor the pump will stop.

The electronic valve will open and close simultaneously to start and stop of pump.

This system could work as well with only a one way valve as element number 3.

An extra security is introduced with the software porgrammed in the mmed in the platte

3.- Electronic controled valve + 1 level water sensor: applicable to pressure systems

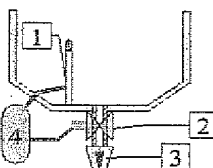


Fig. 4.5.1 Diagrama básico del sistema de extracción. (1) sensor de agua. (2) electroválvula. (3) válvula anti-retorno. (4) electrónica de control.

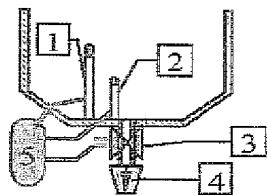
When signal in water sensor the valve will open.

The valve opening time will be calculated considering internal pressure and pipe sections. The valve will be opened during a fixed time consideringa security factor.

The fixed time wil guarranty that only water goes out of the system After this time the valve is closed.

An extra security is introduced with the software porgrammed in the mmed in the platte 6

4.- Electronic controlled valve + 2 levels water sensor: applicable to pressure systems



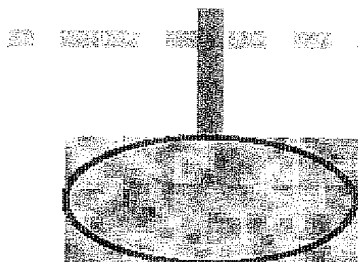
When signal in upper water sensor the valve will open.
When signal in lower water sensor the valve will close.

An extra security is introduced with the software programmed in the microcontroller in the plate 6

Fig. 4.6.1 Diagrama básico del sistema de extracción. (1,2) sensores de agua, (3) electroválvula, (4) válvula anti-retorno, (5) electrónica de control.

2.- Water elimination points

1.- Evaporator



The extracted water is introduced in an evaporator.

The water will be eliminated from evaporator by normal evaporation phenomena.

The evaporator will be mounted in the filter at the bottom.

The evaporation phenomena will be accelerated due to the action of surroundings temperatures. The size of the part will be optimized with calculations depending on material and evaporation velocity of water from this material.

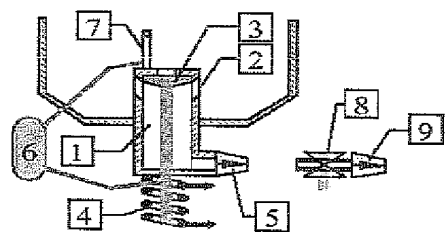
3.- Water elimination system

1.- Evaporation

The elimination of water will be the natural phenomena evaporation.

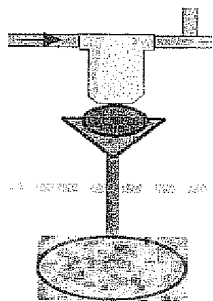
4.- Combinations to be protected:

1.- Volumetric pump + evaporator

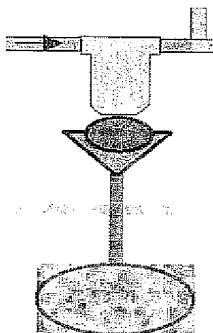
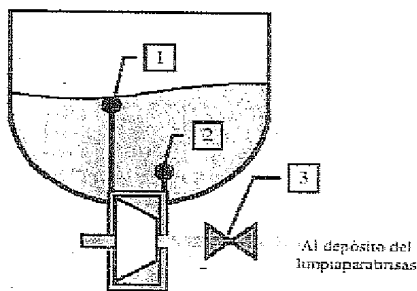


Suction systems: 1 and 2

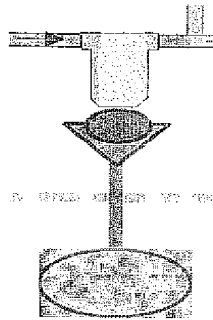
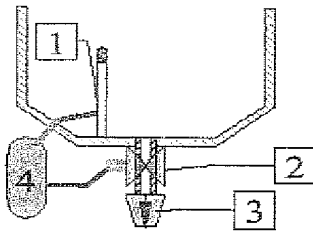
Pressure systems: 3 and 4



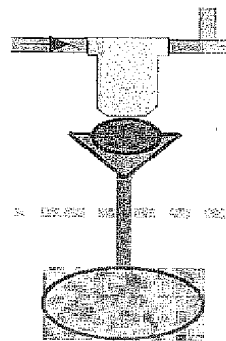
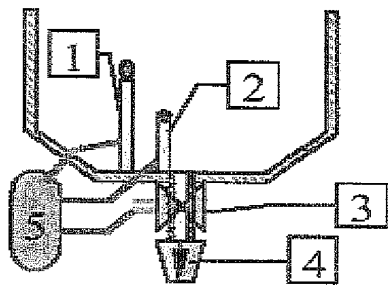
2.- Centrifugal pump + evaporator:



3.- Electronic valve + 1 level water sensor



4.- Electronic valve + 2 levels water sensor




May 8, 2009

DECLARATION

The undersigned, Jan McLin Clayberg, having an office at 5316 Little Falls Road, Arlington, VA 22207-1522, hereby states that she is well acquainted with both the English and German languages and that the attached is a true translation to the best of her knowledge and ability of the first German priority document, DE 102 61 742.2, Attorney Docket No. R. 303860, filed in the German Patent and Trademark Office on December 30, 2002, for United States Patent Application Serial No. 10/540,943.

The undersigned further declares that the above statement is true; and further, that this statement was made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any patent resulting therefrom.


Jan McLin Clayberg

December 30, 2002

Robert Bosch GmbH, 70442 Stuttgart

FUEL FILTER

[0001] The invention relates to a fuel filter, in particular a diesel filter, having at least one fuel inlet, at least one fuel outlet, water separator means, at least one sump, a water outlet associated with the sump, and control means for the water outlet.

[0002] Such fuel filters are used, among other places, in diesel engines for filtering out contaminants contained in diesel fuel and for separating water from the diesel fuel, in order to avoid problems and damage caused thereby, such as contamination or corrosion in the fuel system or poorer combustion in the engine.

[0003] One problem of such fuel filters is carrying the water out of the sump, since after being separated out of the fuel, the water as a rule contains contaminants and therefore must not be given off to the environment without further treatment.

[0004] From US Patent 4,264,442, a fuel filter of the type defined at the outset is known. The fuel filter has a chamber in which there is a cage. The cage defines a fuel inlet chamber, which communicates with the fuel inlet, and a fuel outlet chamber, which is located diametrically opposite the fuel inlet chamber and is separated from it by a partition, and which communicates with the fuel outlet. The fuel entering the fuel filter via the fuel inlet passes through the fuel inlet chamber, emerges from it via a porous wall into the chamber, circles the cage, then on the opposite side of the cage, via an equally porous wall, it enters the fuel outlet chamber, and from there, via the fuel outlet, it flows out of the fuel filter, as cleaned fuel. The bottom of the chamber outside the cage acts as a sump for water that has been separated out in the filtration. On the bottom of the sump there is a valve, which is controlled with the aid of a water level sensor located in the sump and with which a water outlet, communicating with a line, can be selectively opened and closed. If via the sensor it is ascertained that a certain quantity of water has accumulated in the sump, then the valve is opened, via a negative pressure generated at the water outlet, and a substantial portion of the water is exhausted from the sump by suction and carried away to a downstream chamber via the line.

[0005] A substantial disadvantage in carrying water out into such a chamber outside the fuel filter is that the chamber for catching the water must be emptied manually, and in this respect the fuel filter is not maintenance-free.

[0006] This disadvantage does not apply to a fuel filter system known from US Patent 4,637,351, which is refined compared to the system known from US Patent 4,264,442 in that the water outlet communicates, via various lines and chambers, with the air intake and exhaust system of the engine and in that way is subjected to a negative pressure. If the water level sensor ascertains a certainty quantity of water in the sump of the fuel filter, then the valve is opened via an electromagnet, so that the water accumulated in the sump is exhausted by suction because of the negative pressure and is delivered to the air intake and exhaust system. The result is that the water drained away evaporates, either upon combustion or at the tailpipe.

[0007] Although in this system the water is disposed of directly via the engine, there is nevertheless the disadvantage that connecting the fuel filter water outlet to the engine is complicated and hence expensive. Moreover, on delivering the water into the air intake system of the engine, there is the disadvantage that the combustion air, during the dewatering of the fuel filter, is substantially more humid, which impairs combustion, at least briefly.

[0008] By comparison, it is the object of the present invention to make a fuel filter available that does not have the disadvantages discussed above, and in particular in terms of carrying away water can be operated essentially independently of other engine parts and is maintenance-free. The fuel filter should also be constructed simply and thus be favorable in terms of its manufacture.

[0009] This object is attained, in a fuel filter of the type defined at the outset, by means for separating out contaminants from the water to be drained off.

[0010] Surprisingly, it has been found that the contaminants can be separated out of the water comparatively simply, making it possible to carry the water away automatically, directly to the environment. All that must be assured is that only water separated from contaminants, but no fuel, is carried away via the water outlet, and this can easily be done

by way of a suitable setting of the control means.

[0011] Many advantages are thus attained, compared to the fuel filter systems described above. First, manually emptying or replacing filled water chambers is unnecessary, which simplifies maintenance of the fuel supply system. At the same time, a complicated line arrangement for connecting the water outlet to the air intake and exhaust system can be dispensed with. In contrast, the invention makes disposal of the separated-out water possible in a way that is independent of other engine parts. As a result, both maintenance costs and production and assembly costs for a fuel system that requires a fuel filter of the type defined at the outset can be reduced substantially.

[0012] In an extremely simple embodiment of the invention, unlike the fuel filters known before and described at the outset, the sump is associated with the clean side of the filter. The water contained in the fuel can be precipitated out, for instance by way of a suitable coating on the clean side of the filter. Given suitable filter material and/or a suitable coating, the separated-out water that has accumulated in the sump is so clean that it can be released directly to the environment. In that case, the means for separating contaminants out of the water to be released can be made available directly by way of the filter.

[0013] Regardless of whether the sump is located on the clean side or the dirty side of the filter, a filter, in particular an activated charcoal filter, for filtering the water to be released from the sump may be provided as the means for separating out contaminants from the water. This additional filter may for instance be located directly at the water outlet of the fuel filter, or in or at a water chamber downstream of the sump, into which chamber the water from the sump is released. In each case, by means of a suitable filter, it can be assured that the water given off to the environment is sufficiently clean.

[0014] In another preferred embodiment of the invention, a water absorption and evaporation unit downstream of the water outlet and open to the environment is provided as the separation means. Surprisingly, it has been found that the water to be released can be separated from contaminants simply and without additional complicated technical means by means of evaporation and can thus be released to the environment and disposed of without problems. In this embodiment, it must be assured that water that has not yet evaporated is trapped in place in such a way that it does not run off into regions where for

environmental, safety or other reasons it must not be allowed to go.

[0015] For evaporating the accumulated water, the water outlet of the fuel filter is opened until a large proportion of the water accumulated in the sump, or nearly all the water, has run off and been received in the water absorption and evaporation unit; the water outlet is closed again quickly enough that no fuel is released from the sump. The intervals at which the fuel filter must be emptied are as a rule long enough that until the next time water is released from the sump, the previous quantity of released water can evaporate entirely.

[0016] Even if it is unnecessary, under normal ambient conditions and with suitable dimensioning of the water absorption and evaporation unit, to speed up the evaporation, for instance by a purposeful delivery of heat, conditions that speed up the evaporation do exist, especially in an engine compartment of a motor vehicle. For instance, the evaporation can be speeded up by the waste heat from the engine or, given purposeful positioning of the water absorption and evaporation unit in the engine compartment, it can be speeded up intentionally. Moreover, the evaporation can be speeded up by an air stream that is the result of relative wind, or by way of forced ventilation of the engine compartment. Another possible way of speeding up the evaporation is to provide an independent heat supply in the water absorption and evaporation unit, such as an electrically operated heating coil, although in that case an electrical energy supply is needed. Alternatively, the water absorption and evaporation unit may be supplied with heat via the engine cooling system, for instance.

[0017] In a preferred simple embodiment, the water absorption and evaporation unit has a container that is open in an upper region to the environment, preferably made of a temperature-resistant material, such as polyamide. The inflow for the water drained from the fuel filter can be effected for instance via the opening in the upper region of the container, or for instance also via a line on the side or optionally also on the bottom of the container. The opening on the top side of the container can be provided with a fine-mesh covering, by which the water contained in the container is prevented from splashing out. Thus the container acts as a kind of collection basin, from which the water drained from the fuel filter cannot flow out but nevertheless can be evaporated to the environment. The larger the cross section of the container in the region where the water is trapped, the larger is the available water surface area for the evaporation.

[0018] In a further preferred feature, the water absorption and evaporation unit has an absorbent material, which in particular at least partly comprises an absorbent paper and/or is spongelike, and which absorbs water, carried away from the sump of the fuel filter, and holds it until the water has evaporated completely. Depending on the absorbency of the material, it may simply be placed at the water outlet of the fuel filter, without any particular container for it. To prevent the water from dripping out of the absorbent material, however, the material may be located inside a container that then serves as a drip guard. The absorbent material in this embodiment then simultaneously offers protection against the water's splashing out of the container.

[0019] It is fundamentally advantageous if the water absorption and evaporation unit provides the largest possible evaporation surface area for the water. In this respect, the absorbent material preferably has a large surface area. This can be achieved for instance in a spongelike material by means of a riblike structure toward the environment, similar to cooling fins of a heat sink for electronic components.

[0020] In another preferred embodiment of the invention, as the means for separating contaminants out of the water to be drained off, chemicals for binding the contaminants are provided, which are stored either already in the sump and/or in a chamber downstream of the water outlet.

[0021] For the water outlet, various preferred closing systems exist, depending on the location of the fuel filter in the fuel line system.

[0022] For instance, in an arrangement in which there is overpressure at the fuel inlet compared to the fuel outlet and compared to the water outlet, such as whenever the fuel filter in the fuel system is downstream of a fuel pump, a controllable valve is preferably provided at the water outlet. Because then the overpressure, relative to the environment, that exists in the fuel filter, the water is automatically forced out of the sump when the valve opens.

[0023] Conversely, if a negative pressure prevails at the fuel outlet compared to the fuel inlet and the water outlet, for instance whenever the fuel filter in the fuel system is located

upstream of a fuel pump, a pump is preferably provided at the water outlet. The pump is necessary in order to carry the water out of the sump, counter to the negative pressure that prevails in the fuel filter relative to the environment. In an advantageous feature, a volumetric pump is used as a pump; compared to other pumps, it has the advantage that with it a clearly defined quantity of water can be carried out of the sump, making it possible to assure that - beginning at a maximum water level - just enough water that no fuel is released via the water outlet is carried away. In this respect, the use of a pump, in particular a volumetric pump, is advantageous even if an overpressure prevails in the fuel filter relative to the environment.

[0024] The valve or pump can be controlled via water level sensors located in the sump. Particularly if a volumetric pump is used, it suffices to use only one water level sensor in the sump, which displays when a defined water level is reached or has been exceeded, since thereupon a precisely defined quantity of water can be carried out of the sump via the volumetric pump. But even without a volumetric pump, a single water level sensor can suffice for controlling the valve or the pump, for example whenever the controller specifies a defined time for which the valve is to be opened, or the pump actuated, after the specific water level is reached.

[0025] If in another preferred embodiment two water level sensors are used, with which an upper and a lower filling quantity of water in the sump can be ascertained, then the opening and closing of the valve, or the switching on and off of the pump, can be controlled entirely via the signals of the two sensors.

[0026] The invention is described in further detail below in terms of a plurality of drawings that illustrate the principle of preferred embodiments of the invention.

[0027] Shown are:

[0028] Fig. 1, the principle of a preferred exemplary embodiment in a simplified illustration in cross section;

[0029] Fig. 2, a circuit arrangement for controlling the water outlet of a preferred embodiment of the invention;

[0030] Fig. 3, a simplified illustration of an exemplary embodiment for a fill level sensor in cross section;

[0031] Fig. 4, a float-controlled water outlet in a simplified illustration in cross section; and

[0032] Fig. 5, the principle of a preferred exemplary embodiment for a water outlet, in a simplified illustration in cross section.

[0033] In Fig. 1, a fuel filter is shown schematically, with a housing 1 on whose upper side wall a fuel inlet 2 and a fuel outlet 3 are provided on diametrically opposite sides. It is quite familiar to one skilled in the art how a filter for filtering the fuel can be located in a fuel filter housing, and what water separator means should be provided. Illustrating the location of the filter in the fuel filter housing and illustrating the means for separating water from the fuel have therefore been dispensed with, for the sake of simplification. The lower region of the housing 1 serves as a sump 4 for water that is precipitated out in the filtration of the fuel. A water outlet 5 with a controllable closure is provided on the bottom of the sump 4. The closure is controlled via a control unit 6 as a function of the fill level signals of an upper water level sensor 7 and a lower water level sensor 8. A vertical line 9 is disposed on the underside of the closure.

[0034] The line 9 ends in a container 11, located below the housing 1, that is open toward the top. An absorbent material 12 for absorbing water carried away from the sump 3 is located in the interior of the container and extends horizontally over the entire internal cavity of the container 11. The absorbent material may for instance at least partly comprise a sponge, an absorbent paper, or a nonwoven fabric.

[0035] The closure, in a simple version, may be embodied as a valve, if the pressure on the bottom of the sump is greater than the ambient pressure, so that the water can simply run out of the sump when the valve is open. This is the case in particular whenever the fuel filter is located downstream, in the fuel flow direction, of a fuel pump. If the pressure on the bottom of the sump is less than the ambient pressure, then there must be a pump at the closure 4, so that the water can be pumped out of the sump 4 counter to the pressure

difference.

[0036] Via the control unit 6, the valve is opened or the pump actuated, when the water level in the sump 4 of the fuel filter, represented by the line 13, has reached the upper water level sensor 7. Conversely, via the control unit 6, the valve is closed or the pump is switched off when the water level 13 has reached or dropped below the lower water level sensor 8.

[0037] In principle, it is possible to dispense with the lower water level sensor 8. Instead, the control unit 6 can ascertain the time for closing the valve or shutting off the pump on the basis of a time constant, which can be based for instance on empirical data on the outflow speed of the water out of the sump 4. Or, a clearly defined quantity of the water is carried away, which is possible for instance if a volumetric pump is used.

[0038] The water is drained into the container 11, and from there it is absorbed by the absorbent material 12. If so much water is drained from the sump 4 that it cannot be completely absorbed by the absorbent material, then the excess water can drip downward and accumulate on the container bottom. The absorbent material 12 offers protection against splashing out of the water accumulated on the bottom of the container 11, so that pollution of the environment from oil residues or dirt particles dissolved in the water is reliably avoided.

[0039] Given suitable dimensioning of the absorbent material, in the period of time available for evaporation between the times when water is released from the sump of the fuel filter, the water can evaporate completely into the environment. The evaporation is reinforced as a rule by an elevated ambient temperature, resulting from the waste heat from the engine.

[0040] In Fig. 2, a preferred circuit arrangement is shown for controlling the water outlet, with an upper water level sensor and a lower water level sensor. It has a voltage source 21, four switches 22, 23, 24, 25, a relay 26, and a signal transducer 27. The first switch 22 is switched by an upper water sensor and the second switch 23 is switched by a lower water sensor. The third switch 24 and the fourth switch 25 are switched by the relay 26. When the fourth switch 25 has been switched on, the signal transducer 27 is connected to the voltage

source, and the second and third switches 23, 24 are connected in series and are parallel to the first switch 22. Switching on the first switch 22 and/or the second and third switches 23, 24 causes the relay 26 to be connected to the voltage source 21.

[0041] As long as the water level has not yet undershot the lower water level sensor, or in other words a minimum water level has not been undershot, the second switch 23 remains on. The first switch 22 is switched on whenever the water level has reached the upper water level sensor, or in other words when a maximum water level is reached or has been exceeded. With the closure of the first switch 22, the relay 26 is connected to the voltage source 21 and is thereby switched. As a result, the third and fourth switches 24, 25 are short-circuited, so that the signal transducer 27 is connected to the voltage source 21 and outputs a signal for opening the water outlet, for instance for opening a valve or actuating a pump, and water can run out of the sump of the fuel filter. As soon as the maximum water level is undershot, the first switch 22 is opened again. However, this has no influence on the switching status of the relay 26, because it remains connected to the voltage source 21 via the second and third switches 23, 24, which are both still closed. Not until the water level has fallen below the lower water sensor and thus the minimum water level is the second switch 23 opened again. As a result, the supply of current to the relay 26 is interrupted, so that it switches over, and the third and fourth switches 24, 25 are opened again. As a result, the signal transducer 27 is disconnected from the voltage source 21, so that the signal level changes, and the water outlet is closed.

[0042] In Fig. 3, another preferred variant of a water sensor system for determining the attainment of a maximum water level and a minimum water level is shown. The water sensor system comprises a laser 31, which is located on one side of the sump 32 and is oriented obliquely upward. The laser 31 is preferably oriented such that its beam intersects a predetermined level, as the minimum water level, in the middle of the sump. On the diametrically opposite side of the sump, two light sensors 33, 34 are located one above the other; the first light sensor 33 is oriented such that the laser beam, reflected from the phase edge between the fuel and the water, when the water level is at a minimum, strikes the sensor face, and the second light sensor 34 is oriented such that the laser beam reflected from the phase edge, when the water level is maximum, strikes its sensor face. The other components of the fuel filter, such as the water outlet and so forth, are not shown, for the sake of simplicity. A water sensor system of this kind is especially suitable for fuel systems

in fixedly installed, immovable combustion apparatuses.

[0043] In Fig. 4, the principle of a float controller for opening the water outlet 41 at a maximum water level and closing the water outlet 41 at a minimum water level is illustrated. A floating body 42, which is embodied such that it floats on the aqueous phase but is heavier than the fuel, cooperates with a valve pin 43 in such a way that it lifts the valve pin 43 as soon as a defined maximum water level in the sump 44 is exceeded, and it lowers the valve pin 43 again as soon as a defined minimum water level is undershot. The valve pin 43 is guided by a through opening 45 in the floating body 42. On its upper end and in its lower region, somewhat above its valve cone 46 that closes the water outlet 41, it has encompassing ribs 47, 48, acting as drivers, which cooperate with corresponding recesses 49, 50 on the top and underside of the floating body 42. If the floating body 42 exceeds the maximum water level, the valve pin 43 is lifted, so that the water outlet 41 is opened. The valve pin 43 then remains in its raised position until enough water has been drained from the sump that the floating body, dropping along with the water level, presses the valve pin 43 downward, so that once the minimum water level is reached, the water outlet 41 is closed again. A guidance mechanism for the valve pin 43 is not shown, for the sake of simplicity.

[0044] In Fig. 5, the sump 51 of a fuel filter is shown, with a water outlet 52 which can be opened and closed via an electromagnetically closable valve 53, and which is adjoined by a filter body 54, by which the water drained from the sump 51 is cleaned, so that it can be released directly to the environment. The filter body 54 may also be embodied as a sponge, which traps the water, so that it can evaporate into the environment. In both cases, contaminants contained in the drained-off water stay in the filter body 54.

[0045] Many further features for controlling the water outlet or the means for separating contaminants from the water to be drained off or that has been drained off are possible. For instance, as means for controlling the water outlet, final control elements such as bimetallic or memory metal elements can be used, which for instance lift the valve cone counter to a spring force when the water outlet is to be opened. Alternatively, a floating body may be used that cooperates not directly with a valve pin but rather cooperates with a valve pin via a lever mechanism. Filters for cleaning the water to be drained off or that has been drained off that have a system for evaporating the then- cleaned water, or a system for binding

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contaminants by means of chemicals or catalysts, may also be selectively combined with one another.

December 30, 2002

Robert Bosch GmbH, 70442 Stuttgart

Claims

1. A fuel filter, in particular a diesel filter, having at least one fuel inlet (2), at least one fuel outlet (3), water separator means, at least one sump (4, 32, 44, 51), a water outlet (5, 41, 52) associated with the sump, and control means (6) for the water outlet (5, 41, 52), characterized by means for separating contaminants from the water to be drained off.
2. The fuel filter according to claim 1, characterized by a filter for cleaning the fuel, in which the sump is associated with the clean side of the filter.
3. The fuel filter according to claim 1 or 2, characterized by a filter (54), in particular an activated charcoal filter, for filtering the water to be drained from the sump (51).
4. The fuel filter according to one of claims 1 through 3, characterized by a water absorption and evaporation unit, open to the environment, downstream of the water outlet (4).
5. The fuel filter according to claim 4, characterized in that the water absorption and evaporation unit has a container (11) open to the environment in an upper region.
6. The fuel filter according to claim 4 or 5, characterized in that the water absorption and evaporation unit has an absorbent material (12).
7. The fuel filter according to claim 6, characterized in that the material (12) at least partly comprises an absorbent paper.
8. The fuel filter according to claim 6 or 7, characterized in that the material (12) is at least partly spongelike.
9. The fuel filter according to one of claims 4 through 8, characterized in that the water absorption and evaporation unit has a large evaporation surface area.

10. The fuel filter according to one of claims 1 through 9, characterized by chemicals for binding the contaminants, which are provided in the sump and/or in a chamber downstream of the water outlet.
11. The fuel filter according to one of claims 1 through 10, characterized in that a controllable valve (46, 53) is located at the water outlet (5, 41, 52).
12. The fuel filter according to one of claims 1 through 11, characterized by a pump provided at the water outlet (5).
13. The fuel filter according to claim 12, characterized by a volumetric pump.
14. The fuel filter according to one of claims 1 through 13, characterized by at least one water level sensor (7, 8, 31, 33, 34), located in the region of the sump (4, 32, 44, 51), for controlling the water outlet (5).
15. The fuel filter according to claim 14, characterized by two water level sensors (7, 8, 31, 33, 34).

December 30, 2002

Robert Bosch GmbH, 70442 Stuttgart

Abstract

The invention relates to a structurally simple and hence economical fuel filter, in particular a diesel filter, having at least one fuel inlet, at least one fuel outlet, water separator means, at least one sump, a water outlet associated with the sump, and control means for the water outlet, in which the water to be drained out is cleaned by means for separating out contaminants, so that this water can be given off to the environment.

Fig. 1

JAN MCILIN CLAYBERG

PATENT AND TECHNICAL TRANSLATION

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OLAF BEXHOEFT**

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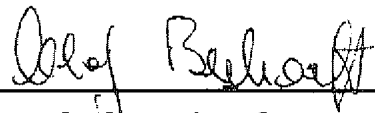
CERTIFIED BY AMERICAN TRANSLATORS ASSOCIATION
* GERMAN AND FRENCH TO ENGLISH
** ENGLISH TO GERMAN

May 11, 2009

DECLARATION

The undersigned, Olaf Bexhoeft, hereby states that he is well acquainted with both the English and German languages and that the attached is a true translation to the best of his knowledge and ability of the second German priority document, DE 103 50 781.7, Attorney Docket No. 303860-1, filed in the German Patent and Trademark Office on October 30, 2003, for US Patent Application Serial No. 10/540,943.

The undersigned further declares that the above statement is true; and further, that this statement was made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any patent resulting therefrom.



Olaf Bexhoeft

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May 30, 2003

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FUEL FILTER

[0001] The invention relates to a fuel filter, in particular a diesel filter, having at least one fuel inlet, at least one fuel outlet, water separator means, at least one sump, a water outlet associated with the sump, and control means for the water outlet.

[0002] Such fuel filters are used, among other places, in diesel engines for filtering out contaminants contained in diesel fuel and for separating water from the diesel fuel, in order to avoid problems and damage caused thereby, such as contamination or corrosion in the fuel system or poorer combustion in the engine.

[0003] One problem of such fuel filters is carrying the water out of the sump, since after being separated out of the fuel, the water as a rule contains contaminants and therefore must not be given off to the environment without further treatment.

[0004] From US Patent 4,264,442, a fuel filter of the type defined at the outset is known. The fuel filter has a chamber in which there is a cage. The cage defines a fuel inlet chamber, which communicates with the fuel inlet, and a fuel outlet chamber, which is located diametrically opposite the fuel inlet chamber and is separated from it by a partition, and which communicates with the fuel outlet. The fuel entering the fuel filter via the fuel inlet passes through the fuel inlet chamber, emerges from it via a porous wall into the chamber, circles the cage, then on the opposite side of the cage, via an equally porous wall, it enters the fuel outlet chamber, and from there, via the fuel outlet, it flows out of the fuel filter, as cleaned fuel. The bottom of the chamber outside the cage acts as a sump for water that has been separated out in the filtration. On the bottom of the sump there is a valve, which is controlled with the aid of a water level sensor located in the sump and with which a water outlet, communicating with a line, can be selectively opened and closed. If via the sensor it is ascertained that a certain quantity of water has accumulated in the sump, then the valve is opened, via a negative pressure generated at the water outlet, and a substantial portion of the water is exhausted from the sump by suction and carried away to a

downstream chamber via the line.

[0005] A substantial disadvantage in carrying water out into such a chamber outside the fuel filter is that the chamber for catching the water must be emptied manually, and in this respect the fuel filter is not maintenance-free.

[0006] This disadvantage does not apply to a fuel filter system known from US Patent 4,637,351, which is refined compared to the system known from US Patent 4,264,442 in that the water outlet communicates, via various lines and chambers, with the air intake and exhaust system of the engine and in that way is subjected to a negative pressure. If the water level sensor ascertains a certainty quantity of water in the sump of the fuel filter, then the valve is opened via an electromagnet, so that the water accumulated in the sump is exhausted by suction because of the negative pressure and is delivered to the air intake and exhaust system. The result is that the water drained away evaporates, either upon combustion or at the tailpipe.

[0007] Although in this system the water is disposed of directly via the engine, there is nevertheless the disadvantage that connecting the fuel filter water outlet to the engine is complicated and hence expensive. Moreover, on delivering the water into the air intake system of the engine, there is the disadvantage that the combustion air, during the dewatering of the fuel filter, is substantially more humid, which impairs combustion, at least briefly.

[0008] By comparison, it is the object of the present invention to make a fuel filter available that does not have the disadvantages discussed above, and in particular in terms of carrying away water can be operated essentially independently of other engine parts and is maintenance-free. The fuel filter should also be constructed simply and thus be favorable in terms of its manufacture.

[0009] This object is attained, in a fuel filter of the type defined at the outset, by means for separating out contaminants from the water to be drained off.

[0010] Surprisingly, it has been found that the contaminants can be separated out of the water comparatively simply, making it possible to carry the water away automatically, directly to the environment. All that must be assured is that only water separated from contaminants, but no fuel, is carried away via the water outlet, and this can easily be done by way of a suitable setting of the control means.

[0011] Many advantages are thus attained, compared to the fuel filter systems described above. First, manually emptying or replacing filled water chambers is unnecessary, which simplifies maintenance of the fuel supply system. At the same time, a complicated line arrangement for connecting the water outlet to the air intake and exhaust system can be dispensed with. In contrast, the invention makes disposal of the separated-out water possible in a way that is independent of other engine parts. As a result, both maintenance costs and production and assembly costs for a fuel system that requires a fuel filter of the type defined at the outset can be reduced substantially.

[0012] In an extremely simple embodiment of the invention, unlike the fuel filters known before and described at the outset, the sump is associated with the clean side of the filter. The water contained in the fuel can be precipitated out, for instance by way of a suitable coating on the clean side of the filter. Depending on the embodiment, an arrangement in which the sump is associated with the dirty side of the filter may be as effective, or even more effective. In that case, the water is separated out for instance with the aid of a coating provided on the dirty side of the filter.

[0013] Given suitable filter material and/or a suitable coating, the separated-out water that has accumulated in the sump is so clean that it can be released directly to the environment. In that case, the means for separating contaminants out of the water to be released can be made available directly by way of the filter.

[0014] Regardless of whether the sump is located on the clean side or the dirty side of the filter, a filter, in particular an activated charcoal filter, for filtering the water to be released from the sump may be provided as the means for separating out contaminants from the water. This additional filter may for instance be located directly at the water outlet of the

fuel filter, or in or at a water chamber downstream of the sump, into which chamber the water from the sump is released. In each case, by means of a suitable filter, it can be assured that the water given off to the environment is sufficiently clean.

[0015] In another preferred embodiment of the invention, a water absorption and evaporation unit downstream of the water outlet and open to the environment is provided as the separation means. Surprisingly, it has been found that the water to be released can be separated from contaminants simply and without additional complicated technical means by means of evaporation and can thus be released to the environment and disposed of without problems. In this embodiment, it must be assured that water that has not yet evaporated is trapped in place in such a way that it does not run off into regions where for environmental, safety or other reasons it must not be allowed to go.

[0016] For evaporating the accumulated water, the water outlet of the fuel filter is opened until a large proportion of the water accumulated in the sump, or nearly all the water, has run off and been received in the water absorption and evaporation unit; the water outlet is closed again quickly enough that no fuel is released from the sump. The intervals at which the fuel filter must be emptied are as a rule long enough that until the next time water is released from the sump, the previous quantity of released water can evaporate entirely.

[0017] Even if it is unnecessary, under normal ambient conditions and with suitable dimensioning of the water absorption and evaporation unit, to speed up the evaporation, for instance by a purposeful delivery of heat, conditions that speed up the evaporation do exist, especially in an engine compartment of a motor vehicle. For instance, the evaporation can be speeded up by the waste heat from the engine or, given purposeful positioning of the water absorption and evaporation unit in the engine compartment, it can be speeded up intentionally. Moreover, the evaporation can be speeded up by an air stream that is the result of relative wind, or by way of forced ventilation of the engine compartment. Another possible way of speeding up the evaporation is to provide an independent heat supply in the water absorption and evaporation unit, such as an electrically operated heating coil, although in that case an electrical energy supply is needed. Alternatively, the water absorption and evaporation unit may be supplied with heat via the engine cooling system,

for instance.

[0018] In a preferred simple embodiment, the water absorption and evaporation unit has a container that is open in an upper region to the environment, preferably made of a temperature-resistant material, such as polyamide. The inflow for the water drained from the fuel filter can be effected for instance via the opening in the upper region of the container, or for instance also via a line on the side or optionally also on the bottom of the container. The opening on the top side of the container can be provided with a fine- mesh covering, by which the water contained in the container is prevented from splashing out. Thus the container acts as a kind of collection basin, from which the water drained from the fuel filter cannot flow out but nevertheless can be evaporated to the environment. The larger the cross section of the container in the region where the water is trapped, the larger is the available water surface area for the evaporation.

[0019] In a further preferred feature, the water absorption and evaporation unit has an absorbent material, which in particular at least partly comprises an absorbent paper and/or is spongelike, and which absorbs water, carried away from the sump of the fuel filter, and holds it until the water has evaporated completely. Depending on the absorbency of the material, it may simply be placed at the water outlet of the fuel filter, without any particular container for it. To prevent the water from dripping out of the absorbent material, however, the material may be located inside a container that then serves as a drip guard. The absorbent material in this embodiment then simultaneously offers protection against the water's splashing out of the container.

[0020] It is fundamentally advantageous if the water absorption and evaporation unit provides the largest possible evaporation surface area for the water. In this respect, the absorbent material preferably has a large surface area. This can be achieved for instance in a spongelike material by means of a riblike structure toward the environment, similar to cooling fins of a heat sink for electronic components.

[0021] In another preferred embodiment of the invention, as the means for separating contaminants out of the water to be drained off, chemicals for binding the contaminants are

provided, which are stored either already in the sump and/or in a chamber downstream of the water outlet.

[0022] For the water outlet, various preferred closing systems exist, depending on the location of the fuel filter in the fuel line system.

[0023] For instance, in an arrangement in which there is overpressure at the fuel inlet compared to the fuel outlet and compared to the water outlet, such as whenever the fuel filter in the fuel system is downstream of a fuel pump, a controllable valve is preferably provided at the water outlet. Because then the overpressure, relative to the environment, that exists in the fuel filter, the water is automatically forced out of the sump when the valve opens.

[0024] A valve for closing the water outlet can be actuated mechanically via a floating body, without requiring electrical water sensors or other electrical components for releasing the water. Once a maximum water level is exceeded, the floating body, located at the phase boundary between the fuel and water, lifts a valve, so that water is released, and it closes the valve again when a minimum water level is reached or undershot, depending on the type of embodiment.

[0025] Conversely, if a negative pressure prevails at the fuel outlet compared to the fuel inlet and the water outlet, for instance whenever the fuel filter in the fuel system is located upstream of a fuel pump, a pump is preferably provided at the water outlet. The pump is necessary in order to carry the water out of the sump, counter to the negative pressure that prevails in the fuel filter relative to the environment. In an advantageous feature, a volumetric pump is used as a pump; compared to other pumps, it has the advantage that with it a clearly defined quantity of water can be carried out of the sump, making it possible to assure that - beginning at a maximum water level - just enough water that no fuel is released via the water outlet is carried away. In this respect, the use of a pump, in particular a volumetric pump, is advantageous even if an overpressure prevails in the fuel filter relative to the environment.

[0026] The valve or pump can be controlled via water level sensors located in the sump. Particularly if a volumetric pump is used, it suffices to use only one water level sensor in the sump, which displays when a defined water level is reached or has been exceeded, since thereupon a precisely defined quantity of water can be carried out of the sump via the volumetric pump. But even without a volumetric pump, a single water level sensor can suffice for controlling the valve or the pump, for example whenever the controller specifies a defined time for which the valve is to be opened, or the pump actuated, after the specific water level is reached.

[0027] If in another preferred embodiment two water level sensors are used, with which an upper and a lower filling quantity of water in the sump can be ascertained, then the opening and closing of the valve, or the switching on and off of the pump, can be controlled entirely via the signals of the two sensors.

[0028] The invention is described in further detail below in terms of a plurality of drawings that illustrate the principle of preferred embodiments of the invention.

[0029] Shown are:

[0030] Fig. 1, the principle of a preferred exemplary embodiment in a simplified illustration in cross section;

[0031] Fig. 2, a circuit arrangement for controlling the water outlet of a preferred embodiment of the invention;

[0032] Fig. 3, a simplified illustration of an exemplary embodiment for a fill level sensor in cross section;

[0033] Fig. 4, a float-controlled water outlet in a simplified illustration in cross section; and

[0034] Fig. 5, the principle of a preferred exemplary embodiment for a water outlet, in a

simplified illustration in cross section.

[0035] In Fig. 1, a fuel filter is shown schematically, with a housing 1 on whose upper side wall a fuel inlet 2 and a fuel outlet 3 are provided on diametrically opposite sides. It is quite familiar to one skilled in the art how a filter for filtering the fuel can be located in a fuel filter housing, and what water separator means should be provided. Illustrating the location of the filter in the fuel filter housing and illustrating the means for separating water from the fuel have therefore been dispensed with, for the sake of simplification. The lower region of the housing 1 serves as a sump 4 for water that is precipitated out in the filtration of the fuel. A water outlet 5 with a controllable closure is provided on the bottom of the sump 4. The closure is controlled via a control unit 6 as a function of the fill level signals of an upper water level sensor 7 and a lower water level sensor 8. A vertical line 9 is disposed on the underside of the closure.

[0036] The line 9 ends in a container 11, located below the housing 1, that is open toward the top. An absorbent material 12 for absorbing water carried away from the sump 3 is located in the interior of the container and extends horizontally over the entire internal cavity of the container 11. The absorbent material may for instance at least partly comprise a sponge, an absorbent paper, or a nonwoven fabric.

[0037] The closure, in a simple version, may be embodied as a valve, if the pressure on the bottom of the sump is greater than the ambient pressure, so that the water can simply run out of the sump when the valve is open. This is the case in particular whenever the fuel filter is located downstream, in the fuel flow direction, of a fuel pump. If the pressure on the bottom of the sump is less than the ambient pressure, then there must be a pump at the closure 4, so that the water can be pumped out of the sump 4 counter to the pressure difference.

[0038] Via the control unit 6, the valve is opened or the pump actuated, when the water level in the sump 4 of the fuel filter, represented by the line 13, has reached the upper water level sensor 7. Conversely, via the control unit 6, the valve is closed or the pump is switched off when the water level 13 has reached or dropped below the lower water level

sensor 8.

[0039] In principle, it is possible to dispense with the lower water level sensor 8. Instead, the control unit 6 can ascertain the time for closing the valve or shutting off the pump on the basis of a time constant, which can be based for instance on empirical data on the outflow speed of the water out of the sump 4. Or, a clearly defined quantity of the water is carried away, which is possible for instance if a volumetric pump is used.

[0040] The water is drained into the container 11, and from there it is absorbed by the absorbent material 12. If so much water is drained from the sump 4 that it cannot be completely absorbed by the absorbent material, then the excess water can drip downward and accumulate on the container bottom. The absorbent material 12 offers protection against splashing out of the water accumulated on the bottom of the container 11, so that pollution of the environment from oil residues or dirt particles dissolved in the water is reliably avoided.

[0041] Given suitable dimensioning of the absorbent material, in the period of time available for evaporation between the times when water is released from the sump of the fuel filter, the water can evaporate completely into the environment. The evaporation is reinforced as a rule by an elevated ambient temperature, resulting from the waste heat from the engine.

[0042] In Fig. 2, a preferred circuit arrangement is shown for controlling the water outlet, with an upper water level sensor and a lower water level sensor. It has a voltage source 21, four switches 22, 23, 24, 25, a relay 26, and a signal transducer 27. The first switch 22 is switched by an upper water sensor and the second switch 23 is switched by a lower water sensor. The third switch 24 and the fourth switch 25 are switched by the relay 26. When the fourth switch 25 has been switched on, the signal transducer 27 is connected to the voltage source, and the second and third switches 23, 24 are connected in series and are parallel to the first switch 22. Switching on the first switch 22 and/or the second and third switches 23, 24 causes the relay 26 to be connected to the voltage source 21.

[0043] As long as the water level has not yet undershot the lower water level sensor, or in other words a minimum water level has not been undershot, the second switch 23 remains on. The first switch 22 is switched on whenever the water level has reached the upper water level sensor, or in other words when a maximum water level is reached or has been exceeded. With the closure of the first switch 22, the relay 26 is connected to the voltage source 21 and is thereby switched. As a result, the third and fourth switches 24, 25 are short-circuited, so that the signal transducer 27 is connected to the voltage source 21 and outputs a signal for opening the water outlet, for instance for opening a valve or actuating a pump, and water can run out of the sump of the fuel filter. As soon as the maximum water level is undershot, the first switch 22 is opened again. However, this has no influence on the switching status of the relay 26, because it remains connected to the voltage source 21 via the second and third switches 23, 24, which are both still closed. Not until the water level has fallen below the lower water sensor and thus the minimum water level is the second switch 23 opened again. As a result, the supply of current to the relay 26 is interrupted, so that it switches over, and the third and fourth switches 24, 25 are opened again. As a result, the signal transducer 27 is disconnected from the voltage source 21, so that the signal level changes, and the water outlet is closed.

[0044] In Fig. 3, another preferred variant of a water sensor system for determining the attainment of a maximum water level and a minimum water level is shown. The water sensor system comprises a laser 31, which is located on one side of the sump 32 and is oriented obliquely upward. The laser 31 is preferably oriented such that its beam intersects a predetermined level, as the minimum water level, in the middle of the sump. On the diametrically opposite side of the sump, two light sensors 33, 34 are located one above the other; the first light sensor 33 is oriented such that the laser beam, reflected from the phase edge between the fuel and the water, when the water level is at a minimum, strikes the sensor face, and the second light sensor 34 is oriented such that the laser beam reflected from the phase edge, when the water level is maximum, strikes its sensor face. The other components of the fuel filter, such as the water outlet and so forth, are not shown, for the sake of simplicity. A water sensor system of this kind is especially suitable for fuel systems in fixedly installed, immovable combustion apparatuses.

[0045] In Fig. 4, the principle of a float controller for opening the water outlet 41 at a maximum water level and closing the water outlet 41 at a minimum water level is illustrated. A floating body 42, which is embodied such that it floats on the aqueous phase but is heavier than the fuel, cooperates with a valve pin 43 in such a way that it lifts the valve pin 43 as soon as a defined maximum water level in the sump 44 is exceeded, and it lowers the valve pin 43 again as soon as a defined minimum water level is undershot. The valve pin 43 is guided by a through opening 45 in the floating body 42. On its upper end and in its lower region, somewhat above its valve cone 46 that closes the water outlet 41, it has encompassing ribs 47, 48, acting as drivers, which cooperate with corresponding recesses 49, 50 on the top and underside of the floating body 42. If the floating body 42 exceeds the maximum water level, the valve pin 43 is lifted, so that the water outlet 41 is opened. The valve pin 43 then remains in its raised position until enough water has been drained from the sump that the floating body, dropping along with the water level, presses the valve pin 43 downward, so that once the minimum water level is reached, the water outlet 41 is closed again. A guidance mechanism for the valve pin 43 is not shown, for the sake of simplicity.

[0046] In Fig. 5, the sump 51 of a fuel filter is shown, with a water outlet 52 which can be opened and closed via an electromagnetically closable valve 53, and which is adjoined by a filter body 54, by which the water drained from the sump 51 is cleaned, so that it can be released directly to the environment. The filter body 54 may also be embodied as a sponge, which traps the water, so that it can evaporate into the environment. In both cases, contaminants contained in the drained-off water stay in the filter body 54.

[0047] Many further features for controlling the water outlet or the means for separating contaminants from the water to be drained off or that has been drained off are possible. For instance, as means for controlling the water outlet, final control elements such as bimetallic or memory metal elements can be used, which for instance lift the valve cone counter to a spring force when the water outlet is to be opened. Alternatively, a floating body may be used that cooperates not directly with a valve pin but rather cooperates with a valve pin via a lever mechanism. Filters for cleaning the water to be drained off or that has been drained off that have a system for evaporating the then- cleaned water, or a system for binding

contaminants by means of chemicals or catalysts, may also be selectively combined with one another.

May 30, 2003

Robert Bosch GmbH, 70442 Stuttgart

Claims

1. A fuel filter, in particular a diesel filter, having at least one fuel inlet (2), at least one fuel outlet (3), water separator means, at least one sump (4, 32, 44, 51), a water outlet (5, 41, 52) associated with the sump, and control means (6) for the water outlet (5, 41, 52), characterized by means for separating contaminants from the water to be drained off.
2. The fuel filter according to claim 1, characterized by a filter for cleaning the fuel, in which the sump is associated with the clean side of the filter.
3. The fuel filter according to claim 1, characterized by a filter for cleaning the fuel, in which the sump is associated with the dirty side of the filter.
4. The fuel filter according to one of claims 1 through 3, characterized by the filter (54), in particular an activated charcoal filter, for filtering the water to be drained from the sump (51).
5. The fuel filter according to one of claims 1 through 4, characterized by a water absorption and evaporation unit, open to the environment, downstream of the water outlet (4).
6. The fuel filter according to claim 5, characterized in that the water absorption and evaporation unit has a container (11) open to the environment in an upper region.
7. The fuel filter according to claim 5 or 6, characterized in that the water absorption and evaporation unit has an absorbent material (12).
8. The fuel filter according to claim 7, characterized in that the material (12) at least partly comprises an absorbent paper.

9. The fuel filter according to claim 7 or 8, characterized in that the material (12) is at least partly spongelike.

10. The fuel filter according to one of claims 5 through 9, characterized in that the water absorption and evaporation unit has a large evaporation surface area.

11. The fuel filter according to one of claims 1 through 10, characterized by chemicals for binding the contaminants, which are provided in the sump and/or in a chamber downstream of the water outlet.

12. The fuel filter according to one of claims 1 through 11, characterized in that a controllable valve (46, 53) is located at the water outlet (5, 41, 52).

13. The fuel filter according to one of claims 1 through 12, characterized by a valve (43, 46) actuated by a floating body (42).

14. The fuel filter according to one of claims 1 through 13, characterized by a pump provided at the water outlet (5).

15. The fuel filter according to claim 14, characterized by a volumetric pump.

16. The fuel filter according to one of claims 1 through 15, characterized by at least one water level sensor (7, 8, 31, 33, 34), located in the region of the sump (4, 32, 44, 51), for controlling the water outlet (5).

17. The fuel filter according to claim 16, characterized by two water level sensors (7, 8, 31, 33, 34).

May 30, 2003

Robert Bosch GmbH, 70442 Stuttgart

Abstract

The invention relates to a structurally simple and hence economical fuel filter, in particular a diesel filter, having at least one fuel inlet, at least one fuel outlet, water separator means, at least one sump, a water outlet associated with the sump, and control means for the water outlet, in which the water to be drained out is cleaned by means for separating out contaminants, so that this water can be given off to the environment.

Fig. 1